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The Emotion of Joy

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THE EMOTION OF JOY.

It is the main purpose of this essay to outline a description of the Emotion of Joy in both its aspects, psychical and physical. On the one hand we shall try to set forth what the emotion 'feels like,' and on the other to point out the chief concomitant bodily movements, strains and postures and to explain, so far as may be, by what biological principles these are what they are seen to be.

The concept which should be perhaps suggested to the serious scientist more often than any other by the work he does is the concept of complexity. However numerous and comprehensive, generalizations always fail to keep pace with the infinite detail which the senses of the seeker offer to him. Through description, then, of smaller and ever smaller portions of subject matter, it would seem that some compensation might be obtained for this discrepancy. Thus it is that one emotion, out of all the indefinite many all men know, is at present a proper division of the affective field. Each 'emotion' is a mode or habit of action by itself, and one by one each needs explanation and description founded on basal principles possibly common to them all. But before taking up the discussion of the single emotion selected as the subject of this research, we shall express certain considerations on the nature and process of emotion in general, thus making more definite our meaning as regards joy.

Only one variation in the affective terminology which is perhaps the most common will be employed in this essay, and that is one which the kinæsthetic theory of emotion almost necessitates if it is to be scientifically set forth. The term 'expression' as applied to the bodily movements of emotion has not only lost its force, but is distinctly misleading. For my own

use, therefore, the more fitting term *extramotion* has been devised, correlative to which *intramotion*, referring to the mental or sensational side of affective phenomena, will be employed. Inasmuch as the body-movements, in part at least, are perceptible from without and their concomitant quantums and quales of consciousness experienceable only as it were from within, these terms have a certain logical basis, while it is important that the complete correspondence of the two orders of events should have some sort of expression in the terms employed in discussing them. Above all, is it essential to avoid such words as imply the primacy or superiority of either the psychical or the physical orders of emotional events. In this essay, then, intramotion may be taken to stand for the consciousness factor and extramotion for the somatic factors of movement and tendencies to movement. Should the term 'expression' be employed, as may at times happen for convenience sake, it should be understood in the sense now sufficiently indicated.

In this condensed essay any proper discussion of feeling as such can have no place; a page or two will suffice in which to set forth the notion of it here presupposed, while its more practical implications follow.

Only experience of them can, of course, convey the meaning of the feelings. Theoretically, however, in its essential nature feeling seems to be roughly definable as the reaction of personality upon the sensations which constitute its psychological basis. It is owing to the complexity of the self, therefore, that there are in organic experience such a multitude of feelings and that these are interwoven into such a complicated mass of sentiency. As chief part always in any feeling, analysis discriminates bodily sensations, correlate to the action of the many sense-organs connecting the subject with its physical environment. Second, there is a constant ideal element, derived from the memory-mass of cognitions and of affective 'traces.' It is this element of feeling which chiefly differentiates in consciousness feeling from mere sensation as abstracted by the psychologist. It seems to be the relative proportions of these two factors which give the extraordinary variety to the feelings,

the one regularly decreasing as the other becomes more evident in consciousness. The ideal element indicates an awareness of the meaning, causes and mechanism of the feeling experienced, thus ministering to the understanding, while the sensational element or elements express to the subject the immediate aspect of the self as reacting upon its surroundings. To a naïve lover of fine music, for example, the sensational elements furnish pleasure and little technical knowledge of the art of the composer and the players, but should this auditor become a technical musician, the intellectual factor would increase at the expense of the agreeable feeling-tone. A third element of feeling comes from the psychophysical habits of any subject as expressive of the life-purpose of that self. It is this last factor which makes each person's feelings so different from those of every other, while the reaction and interaction between the various combinations of these habits help to increase to the greatest intricacy and variety the feelings within the experience of any subject.

However important to the doctrine of emotion and allied states of consciousness pleasantness and unpleasantness may be, we shall in this essay have little or nothing to do with pleasure and pain as such. Indeed, it is a presupposition of this present description that this discrimination is an important one for the scientific clearing up of the nature of affective states. Leaving to histological neurology the ultimate decision as to the existence of organs (peripheral, central and intermediary) belonging to pleasure and pain, we shall get along very well for all the indecision, being confident that emotion gets its affective tone, whether agreeable or the contrary, from organic conditions far more general than any that could be concerned in the neural structures rendered probable by the work described by Dr. H. Nichols and others. This distinction seems one of the most basal that can be made in this direction, for whether the physical basis of the discrimination be or be not discovered and proved in the nerve-fibers and nerve-cells, every person capable of a degree of introspection must know an absolute difference in kind between unpleasantness and pain as between pleasantness and pleasure properly so called. The intricacy of the primitive fibrillæ of nerve tissues maintained by

Max Schultze, Apáthy, Bethe and many other competent scientists makes the proper physical basis for the distinction as experience proves it, whether end-organs and the rest exist or not. Pleasantness and unpleasantness, on the other hand, seem much rather derivatives from certain nutritive conditions of the organism and from the self's reaction to conditions of a psychic nature attending its furtherance and hindrance than conditions of any sort dependent immediately on neural functioning. It is these feelings which alone are concerned in the nature of emotion; they are an innumerable multitude of states of consciousness, and include those classed as æsthetic, moral, social and the rest, a mass unnamed as they are unnamable in their closely interrelated confusion. It is with these, each with its large substratum of agreeableness and disagreeableness, that the theory of emotion is concerned, and never, save by accidental coincidence, with pleasure or pain proper—with the pains which more or less cut and bore into the soul or with the pleasures which are concerned with the primal and powerful biologic needs of life. Too little all through psychology, and especially in 'esthetology,' have the biologic principles of the psychophysical subject been considered. It is as it was and still is in part with Medicine: the abstraction of aspects needful to a complete and detailed science has caused too much attention to be given the special aspects, while all the time the proper object of research is the *total organism of mind and body*, the inheritance of myriad generations of development and evolution—a unity ever, in a sense, yet dependent always on a larger unity, and everywhere and always inevitably complex with biologic determinants pervading its every function. Such is the organism of whose life emotion is a part. It seems as unscientific to consider emotion unbiologically as to treat it as a purely psychic process, and into neither of these errors shall we fall, however inadequate such an essay as this may be to discuss properly the biologic field of affective states in any organism whatever, and most of all in man.

The so-called kinæsthetic theory is the foundation of the conception of emotion here to be discribed. Indeed, it is considered that this doctrine, as yet in its details and preciseness

of statement relatively new, is the only one which can be harmonized with the modern trend of biology, evolutionary and 'monistic.' Only the broad curves of this plea of William James and Lange have yet been drawn; the details giving it completeness the years must gradually and laboriously supply.

Emotion is but a form of psychophysical experience abstracted for scientific convenience from out the empirical continuum of a living organism. The two sides run along together and states melt insensibly into each other. We cannot claim to hold that extreme degree of inassurance as to a definition of emotion which, for example, Professor Irons expresses when he in a recent article calls emotion unanalyzable and irreducible, an ultimate and primary aspect of mind; for feeling, proper, such a characterization would answer better. Here, almost more than elsewhere, introspection is of value, not perhaps at the precise time of the emotional experience, but just afterward, when its strongly affective intramotion and memory of its lively extramotion are both, perhaps, fully recallable and describable.

Again, it is apparent that observation is important and remunerative in the case of emotion because of the latter's essential bodily aspects, to be plainly seen, in part, in other organisms both brute and human. The psychologist himself may be, to be sure, of that calm and unruffled habit of mind that is proverbially the nature of the true philosopher, but his friends, his maidservant (very likely), butcher, cook, even his opponents in psychological discussion, not less than his house-cat and saddle-horse and the wilder acquaintances of his summer haunts, are sure to display emotions which he can study with no little advantage.

Emotion, then, appears in general to be a temporal abstraction from the continuum of our sentient experience, voluminous in its affective tone rather than acute, filling for the time the whole field of consciousness and that in a peculiarly 'extensive' degree. As emphatic expressions of the biologic purpose of the individual emotions are peculiarly inclusive of the whole consciousness for reasons which we shall later on attempt to explain. On the other aspect, namely the bodily, emotions are also as extensive as possible, recent physiological science making it

probable that in a literal sense every portion of an organism supplied with nerves receives and partakes in the reverberation of an emotional event, undergoing both material and psychic change.

Emotions empirically have an indefinite number of variants in the two directions of quality and quantity. Besides the different emotions themselves, so numerous and interrelated that no one as yet has seriously attempted even to make a list of them, there are an indefinite number of qualities possible to each, while each empirical shade of each emotion may be felt in a further indefinite number of degrees of intensity. These facts are axiomatic—but unexplained. Where is one to search then for the determinants of all these affective states ?

The psychologue who does not as yet think his or her psychology in parallelistic terms would answer this question by referring simply to the free activity of mind as an independent principle, or else fall into the confusion which the halfway mode of belief sooner or later necessitates. As we have already said in substance, it is the hypothesis upon which this essay rests that, metaphysics aside, mind and body act in some kind of unison, however incognizable this may appear upon a cursory comparison of experienced feelings and contemporaneous bodily states for any given period. Such being the case, it is interesting to inquire how the states of mind are accompanied by states of the body. There is no pretense of having solved in any sense this immensely complicated problem, but even the roughest outline is here not out of place.

Just as the psychic side of an emotion is a total 'block' of consciousness more or less complete at any moment, so, and more completely so in a way, is the body a physiological unit, as already has been suggested. As it has done harm, howbeit perhaps necessary harm, to mental science to consider its 'faculties' and its 'ideas' as independent entities and *realen*, so physiology and even anatomy have at times failed to gain their best results because they have abstracted too much and kept too close to the methods of the scalpel and the microscope. Parts belong together, work together, and are parts only because a whole allows of their existence and common functioning. This

is as true in the description of the emotions as it is elsewhere. A whole of psychic experience occupying, say, a minute of time is correlated by a like period of bodily strains and movements. But the psychic aspect of this complex event has innumerable possibilities of both quality and quantity—what bodily conditions correspond? We can be confident of answering the question philosophically if we say, The whole body with all its complexity corresponds, but its parts in very various degrees. A volume might in time suggest something of the detail here implied; such a volume would have interest, and the physiological psychology of the future will surely write it!

One would need to search in particular among the nerves, the bloodvessels, the muscles, the joints and the glands for the correlates of the intramotions of emotion. In nerves we include the brain and its ramifications so infinite in number and so omnipresent that they represent almost exactly the form and contour of the whole body, as a certain foreign masterpiece of dissection and maceration has demonstrated. By bloodvessels one includes the heart and its tubes, with the lymphatic system, nearly as universal in the body as the nerves. The muscles too are a unified mechanical system ranging in location from the upper fibers of the Occipito-frontalis to the Plantaris, and in size from the Stapedius to the Vastus externus. The joints are both numerous and very various, and especially rich in organs of sense. The glands, finally, have a part in affective correlation too often neglected, although they include such masses of nerve-accompanied cells, tingling with physiologic and chemic life, as the liver, alimentary system, testes, and mammæ, besides numerous other small but important glands scattered about the tissues. And from all and between all these and various many other busy structures of the higher animal frame, nerve fibers extend, making of their undescribed manifoldness a unity. It is to some such material structure as this that every emotional intramotion is concomitant—to a growth with its every cell alive and warm and significant with energy. These functioning structures vary, as the emotions do, both quantitatively and qualitatively, and both indefinitely.

As to the *nervous system*, what these variations are in either

mode is still undetermined, but they are doubtless most important. Very likely the correlations of difference which are the most essential arise in the various combinations of neural elements which obtain, in the mode of their association. This is Wundt's way of viewing the varieties and shades of emotion, and it has a certainty as far as it goes. But the brain is not the only neural organ whose action is concomitant in emotion; indeed it seems proper to think of the brain as a sort of switchboard of the varied movements and strains of the body. As to its intramotive aspect, the relations between feeling and the neural processes are much more intimate and what the Materialists (if any remain) would call causal. The importance of the very numerous ganglia scattered throughout the body must not be underestimated, for they seem to be essentially little brains placed conveniently for the more certain control over or service of the organs in or near which they lie. The nerve trunks, again, doubtless have something to do directly with the variations of the emotions.

The states of the *vascular system* are scarcely less various than those of the nerves. The blood-pressure varies within very wide limits, determined both by the heart rate and by the tone of a double set of muscular fibers in the arterial walls, as well as by the temporary state of the general nutrition. The relation between these variants and the neural variants is yearly becoming better known, as is its meaning for the individuality of the agent.

The feelings which are involved in the movements of hundreds of *muscles* and joints, each very rich in nervous instruments, and pressing ever variously on nerves, bloodvessels and glands, one would expect would be unclassifiable and unanalyzable, as experience proves them. It is only necessary for one to scowl and attempt to feel good-natured without unruffling his brow to learn how important are these tissues of infinite cells as determinants and variants of emotion. Under these circumstances it is possible to force into the fovea of consciousness thoughts which represent good nature, but in nowise, for the writer at least, an *affective* tone of amiability while the muscles scowl. This fact is no proof that practice, as by an actor,

could not train the muscles to act independently of any feeling whatever, though it is certain that this is rarely the method of the greatest histrionic artists. For example, to Mrs. Siddons, who made great a success of imitating real affective positions and movements as few have done since, her acting was her womanhood and her womanhood her work. It is very probable that a census taken of actors and actresses whose art is of the highest success would give a strongly predominant proportion in the same direction. Art can do much, but that art does most and best which follows the methods of Nature. However perfect the apparent mechanism and the French art without, the astounding chess-playing automaton always has a real man within.

Recent researches[1] with the aid of the Röntgen rays on the movements of the stomach of the cat during the digestion of a meal showed in a most striking manner, that any slight vexation of the animal stopped with surprising promptness and invariability gastric contractions and movements of every sort. Thus is proved what many a man has suspected to occur in his own epigastrium in attacks of indigestion from some slight worry or feeling of haste.

The *joints* are only the hinges on which the bones turn upon each other, but they are portions of the body very well supplied with nerves most essential in the instinctive and voluntary movements of the frame. The joint and the muscular sensations combined form a mass of high emotional value, a combination however with a cœnesthetic timbre not further reducible by analysis.

But again, the *glands* give to consciousness (if this expression may for convenience be allowed, the materialistic implication being disavowed) a set of elements which in some emotions are of the very highest moment. The action of the large glands of digestion, liver, pancreas, etc., stops promptly on the accession of a shock of grief or of anger; tears both of grief and of joy are everyday phenomena, as are the diarrhœa of nervousness or of fear and the sweating and other glandular activity of amorousness and of extreme terror.

[1] W. B. Cannon, *Am. Jl. Physiology*, May, 1898, Vol. I., No. III.

As a formula for scientific use a definition is of interest, but in case of a function so complex as emotion the construction of one, comprehensive yet simple, offers no little difficulty. This might be suspected from the greatly various attempts which have been made by mental scientists. In the first place, disagreement as to the nature of emotion is extreme, and dispute as to its proper natural limitations makes the matter worse. When the meaning of the word psychology itself is taken with so various values by its devotees, this disagreement is not surprising. As has been already suggested, emotion is the most complex of the aspects with which the psychologist has to do, and we should hardly expect that a definition would not correspond. It is not enough to say it is just this and that without qualifying or enlarging, for emotion seems to be no one simple somewhat but rather a complex of many. It will be convenient to express here, then, in as concise words as possible the present conception of an emotion, to be enlarged upon and explained later on:

Emotion may be said to be *a temporal portion of excited sentient experience wherein the subjectivity and the psychophysical attention to the object, real or ideal, are heightened with or without a tone of pleasantness or of unpleasantness, and wherein the feeling and the bodily position or movement are, or tend to be, characteristic and correlative.* Such a descriptive definition of emotion does not attempt to make known the meaning of an affective state to one who has never experienced it (although, of course, such a sentient being does not in fact exist), but it may well serve, at least, as a brief syllabus for future elaboration as well as a general résumé of observations and experiments.

Inasmuch as the last of the considerations of this formula will doubtless seem to the opponents of the so-called kinæsthetic theory (who, although decreasing, are still to be found) the part most in need of evidential confirmation, it may be proper to suggest certain propositions which certainly strengthen its general validity as a working descriptive hypothesis.

The relations existing between the extramotion and the intramotion of emotion have been the stumbling-block of un-

believers and the key-note of most of the objections which they have raised against the theory. The chief of these facts regarding this relation is undoubtedly the double circumstance, first, that in some cases at least the artificial production of bodily movements apparently like those of an extramotion gives in consciousness no proper emotion, while, second, that one often experiences emotion, in the sense of affective consciousness, without any obvious attending extramotion. To offer suggestions which would explain away this apparent discrepancy would be to make the kinæsthetic theory, in the present advanced stage of psychological physiology, acceptable to practically all modern-minded psychologists and physiologists. A beginning at this is attempted here, although the evidence in favor of the theory from recent researches in physiology as a science interconnected everywhere with psychology; from almost universal introspection by men; from observation on the lower animals; from actors who strive to base thoroughly imitative performances on introspective study of their method; from study of children under natural conditions; from careful introspective opinions of eminent and conservative psychologists in America and Europe; and from the natural presupposition of its truth; has grown into so convincing a mass of demonstration that there arises a proper demand for an explanation of the apparent facts that seem to tell against it. Most important by far of these apparent facts are the two, really but aspects of one circumstance, cited above.

It is not to be expected that any considerable number of psychologists will ever accept a dictum that emotion is nothing more nor less than the joint and muscle sensations which arise when the body moves in whole or in part. Stated in this bald way, as it was once unfortunately (perhaps for emphasis), the statement is undoubtedly untrue, because grossly incomplete; emotion is not so simple nor so easily explained and described. But this is the basis from which objections on the first score have been oftenest raised. Emotion, as analysis finds it, is indeed much more complex. For this purpose one must especially bear in mind the component which we have suggested as self-reference, or subjectivity, and that other, not less and perhaps

more essential, namely, excitement. In a mere muscular imitation of an extramotion for experimental purposes neither of these is present in any proper sense in which it should be understood. Especially is there then no involvement of the biologic egotism of the subject; the aims and purposes, the honor, the satisfaction, the safety of the ego are not touched, are in no wise concerned. The movements artificially made have no proper meaning for the subject and are inevitably different on this account. Nothing has happened to stir up the cellular interest, so to say, of the agent in any such sense as emotion of necessity stirs it up. No suggestion is offered him that his ego is then in such relation with an object, real or ideal, that its feelings must be involved. In no way are the conditions parallel save in that the experimental and artificial movements cause sensations which presumably or theoretically are like those of emotion. This is on the presumption that the movements are imitated exactly, which is a doubtful supposition for any deliberate movement whatever. But any artificial imitation of an extramotion can by no means adequately represent the far-reaching and innumerable movements which are correlate with emotion: it is as if one should compare the basal theme of Tannhauser grandly played on a great organ with the sound of its air drummed with one finger upon one of the keyboards. Many of the muscles, perhaps most, innervated in an extramotion are wholly beyond the will's control. But more important than this, the larger mass of the feelings making up the substance of an intramotion are concomitant also to various movements other than muscular, and perhaps far within the body; vascular functions and glandular, secretive and excretive, of whose effects and innervation the agent is never conscious in any degree as disparate movements but which combine their multitudinous factors to make up the whole of the affective experience. From such considerations as these it is at once obvious that the conditions of mere cold experimental imitation of an extramotion and those of a natural emotion, vital and tingling with every phase and element of organic excitement, are wholly different, of necessity. Imitation of the conditions of the body in emotion is wholly impossible.

As regards the second part of the argument against the kinæsthetic theory, namely, that 'emotions' are often experienced when no obvious bodily movements occur at all (and this is the more valid of the two, by far), more complicated and far-reaching considerations have to be suggested, involving wider truths.

In the first place, the considerations as to the nature of the extramotion just now mentioned apply to this objection in a still more emphatic way. The bodily concomitants are not so simple and obvious to view as the objectors seem to suppose. The underlying and perhaps most essential elements of the extramotion are not visible to external view at all, but consist in a general and exceedingly complex stimulation of all, more or less, of the organic functions. Even in the case of the action of the muscles which are attached to the bones and move them, or which cause changes of place in considerable portions of the external tissues, at times easily visible, the fact that under affective conditions their contraction is not roughly visible to an on-looker is no proof whatever that the contraction does not in some measure occur. The manner in which the muscles are each enclosed in gliding fasciæ and packed about at times with fat allows of movements which from without are wholly invisible. A contraction, for example, of the facial muscles sufficient to entirely change the expression of the whole face may be brought about by molar changes so small as to be not at all definable, or only with great difficulty, by those most familiar with mimetic and the structural facts. It is only the grosser degrees of muscular contraction or relaxation which are apparent from a distance, while the vascular and glandular and internal muscular changes are not observable at all. It must be obvious that it is not that extensive muscular movement which bends the limbs or expands the chest to which a theory of emotion as a scientific doctrine properly refers, but that rather there is intended that theoretic sort of contraction which is indicated by the transmission of a motor impulse from the center to the contractile organ, which might respond visibly or not. Considerations homologous to this are pertinent for every sort of physiological unit concerned in an emotion, but they need not be set forth here.

It is continually obvious and it is one of the notable affective principles that cultured adults, among whom we need postulate no lack of emotive experiences, oftentimes exhibit little sign of emotion, and that, too, at times when it is reasonable to be sure that their consciousness is of a strongly affective tone. This fact does not apply to the lower animals, to savages, nor to naïve civilized children save in proportion to their culture, but yet the objection under discussion has been made from observation on the least natural class of humanity, the cultured adults. This objection may be met as follows, however inadequately set forth the facts may be.

The likeness of emotion, psychophysically, to attention, a somewhat less complex scientific abstraction, will be apparent to all who compare them, and the similarity has been noted in several descriptions of affective states. This likeness is a fundamental and far-reaching one, as may be seen from a definition of attention; it is fairly statable as follows: Attention is a state of psychophysical strain pointed by interest in certain directions for the purpose of aiding clearness of consciousness, and experienced as a cœnesthesia of bodily movements inhibitory or active; it is discrete in occurrence and either reflex or voluntary. Emotion is a sort of attention to an object either external or ideal, and it has as an essential component a complicated set, indeed a set of sets, of bodily movements or tendencies to movement, which act, however, always reflexly and run a more or less constant course throughout, both in space and in time. The chief characteristic of attention which is of interest to us here, however, is the fact that the process in question is mainly of a nature describable as *inhibitory*. So far in psychology and in physiology, research into the character of inhibition as a somewhat for scientific discussion has been wholly inadequate to its importance. Something has been accomplished as to the interference of percepts with each other, but that much larger and more important aspect of the subject which concerns the muscles and other organs and innervation in general has been neglected, explanatory facts herewith implicated being far to seek, and it is this mode of inhibition with which emotion and attention are in the main concerned.

It should be borne in mind that the notion inhibition does not of necessity imply that the process is in any sense a negative process, save as the grosser movements of various sorts as seen from without are concerned; in the sense that motion of this kind does not occur, while in states other than inhibitory it might occur, it is a negative conception. But, as already pointed out, movement of this manifest sort is not the whole effect following on innervation of centrifugal nerves—strains may be produced, or even conflicts of neural energy which give no peripheral sign to perceiving ejects at all. Inhibition seems to mean practically the non-action which obtains contrary to what the instinct or habit would ordinarily occasion under more or less different conditions. From such a point of view the manifestations of inhibition are both numerous and important. All of the conditions in which the conscious focus passes rapidly from one object to another, such as hysteria, delirium, mania, seem to be states in which there is a deficiency of outer inhibition, while the opposed case, habits of repression, thought, voluntary action, delusions, ecstasy, melancholia, arise from a relative excess of repression from consciousness of the environment except the object attended to. The extramotion of emotion is in a proper sense a reflex attention to an instinctive, because vastly long inherited, series of bodily habits—habits based on principles which form the very groundwork of organic function.

Thus emotion is a complex sort of attention to one series of feelings and movements in the body, other considerations being by this circumstance excluded. But just in proportion as these other considerations, extrinsic to the emotion, enter the habitual series of neural events (whether consciously or unconsciously from the effect of early habitual repetition it matters nothing), the usual, theoretically complete, extramotion is changed or lessened or, apparently, from an external and cursory viewing, wholly suppressed. There is then inhibition of the instinctive motor ideas of the extramotion, a retention of these ingrained 'ideas' out of the usual reflex arc. It is pertinent to conjecture (and it is scientific in lack of proved facts as to the neural currents,) that in this process the nervous energy which in a wild animal, savage, or quite naïve child would have gone into

the motor centers for the natural extramotion, will now be expended quite as completely, but through different neural paths and centers, perhaps resulting in a motionless balance of the bodily parts concerned, but certainly, in most cases at least, in such a way as to enliven the intramotion and make it often more intense.

> "The still, unuttered, silent, wordless grief
> That evermore doth ache, and ache, and ache,
> This is the sorrow wherewith hearts do break." (E. W. W.)

This indeed is a notion so very common in literature and speech everywhere that no psychologist can properly doubt its truth or avoid explaining it save on the presupposition that the psychologist alone knows human nature and the poet and the æsthete not at all. But be that as it may, the parallelistic doctrine of the relation of soul and body gets no little of its strength from its unconcern with the physical principle of the conservation of energy. It, therefore, is a gratuitous supposition that the energy involved in the two cases in comparison is equal, and it becomes a matter of empirical fact in the light of biological principles.

It has been a mistake of various treatments of the nature of emotion that the theory of evolution has not ordinarily been assumed as underlying its phenomena; thus must be considered every discussion of affection which draws conclusions from events in men alone, not deeming them animals at the apex of an infinite pyramid of others, but as loci in themselves sufficient for the adequate study of emotion's nature. Many a scientist still is loth to think of himself as the descendant of the past, failing to discriminate the criteria whereby man is man from those whereby he yet is brute. It surely is not the adult of the highest culture which our period knows who can best furnish us with an exhibition of emotions for our study; he is of all organisms we know the furthest removed from the average nature of animal function, and the study of his affective states can but lead astray in theorizing, however necessary it may be in practice to use him alone as subject in the laboratory. Many complex conditions peculiar to man, chiefly *social*, have placed him in a higher class apart, and proportionally *out* of the biologic series fading in the past behind him.

The proper standard of the extramotion of any emotion is to be obtained from study of the whole scale, more or less, of the animal kingdom, of absolute savages, and of infants not yet come under the influences of civilization proper. Many animals, of course, as well as relative savages and most children, have lost their biologic integrity in varying degrees, and display emotions, therefore, in proportional grades of imperfection.

Taking, then, as the well-understood though relatively undescribed set of extramotions that typical series of physical and chemical actions to be observed in organisms, of sufficient degree of evolution, retaining their organic simplicity, let us consider some of the conditions which in the highly artificial order of our civilized life tend to suppress the extramotions in very numerous cases, so giving rise to unwarranted objections as to the affective relations of body and soul.

Pursuant to the conditions of civilization and in particular of man's necessary struggle for existence, an intricate system of restraints and artificial restrictions has been gradually and inevitably developed by many centuries, how many no man dare say, of constantly acting motives leading to continually deeper-fixed modes of willing and conduct. Many of these motives for inhibition have brought about habits which are in effect instincts, and so numerous are these that in civilized lands it is uncommon to find any emotion expressed in the case of adults in that perfection of naturalness which elsewhere and among wild animals regularly obtains. In the infant the inhibitory process is begun regularly in its earliest months, and continues, either by deliberate instruction or by example or else imitatively, through life, none escaping wholly and few in any considerable degree from the all-mastering force of this advantageous restraint of once-natural bodily functions. Even the domestic animals display something of this universal influence, and one must go to the jungle or the bush to see what may be properly termed a natural extramotion. As remarks Gabriel Compayré in a recent book[1]: "Il y á presque toujours disproportion entre les faculteés expressives et les impressions ressenties; mais tandis que dans l'age mür, l'expression reste au-dessous de la realité,

[1] 'L'evolution intellectuelle et morale de l'enfant,' 2d ed., p. 110.

dans l'enface elle la dépasse," the latter consideration being a consequence of the undeveloped faculties of the very young child. The inhibiting motives are in reality complex and inter-involved to a degree proportionate to the social intricacies from which they have arisen; we can, however, suggest a few of those which act directly to restrain such of the emotional expressions as would be manifestly harmful to some degree to their subject, and some of these are here denoted, as applicable to ten of the commonest and most pronounced and well-defined of emotions.

MOTIVES FOR EXTRAMOTIVE RESTRAINT.

Fear.—Desire to be thought brave. Disadvantage of displaying fear to adversary. Better power of defense through muscular and other bodily control.

Anger.—Know personal and social advantages of peace. Habitual politeness. Cowardice. Policy. Sympathy.

Love.—Modesty. Prudery. Coyness. Honor.

Grief.—Fear of ridicule. Fear of pity. Modesty. Resignation. Vanity (wrinkles). Policy. Pride.

Hate.—Advantages of peace. Policy. Politeness. Benevolence. Cowardice. Self-respect.

Shame.—Pride. Arrogance.

Pride.—Fear of ridicule. Policy. Politeness.

Surprise.—Policy. Politeness. Pride.

Contempt.—Cowardice. Policy. Pride. Sympathy.

Joy.—Dignity. False politeness. Modesty. Policy. From reflection, by contrast, on grief and pain. 'Other-worldliness.' Pessimism. Vanity.

We will now leave the consideration of emotion in general and devote ourselves more particularly to Joy, although the whole of what has been thus far said applies toward a description of this emotion.

It were idle to set down, even for system's sake, in this abridged monograph, a detailed account of what a period of joy feels like to its subject-agent, for, as the fundamental emotion of all life, all persons are familiar, in some degree at least, with its appetible nature. It is enough to say that it forms the ideal

experience to all naturally-minded mortals, and, eternalized, is the heaven most men look for. Immediate and retrospective introspection, however, makes easy an analysis of joy, as of other emotions, which has descriptive interest. The components suggested by this analysis have already been in the main intimated in the definitional formula of emotion as such given above, and need to be only somewhat enlarged upon as regards their details in the case of joy.

We distinguish five components in the state of delight we are considering. These are (1) Psychophysical excitement; (2) Various feelings and their concomitant bodily movements and strains; (3) Heightened consciousness of the emotion's object as in relation with the subject-agent; (4) A pleasant tone of consciousness, and (5) Increased self-reference. Under these five heads apparently the aspects of any emotion may be ranged, the appropriate changes being made in the fourth for the emotion considered. These are not separate in any actual sense, but are abstracted from the totality of the experience-period for study, as are often the clangs in a chord. The spirit of joyfulness all men know; let us glance at its components for psychology.

1. The psychophysical excitement of joy is the quantitative aspect, or intensity, of the emotion. This may vary within limits which are far apart, from a mere slight increase in the interest which the emotion's object has for the agent to a degree of excitement making all things else unperceived and the feelings themselves so intense as to reach a form of ecstasy or rapture in which the self is lost. Ordinarily, however, the excitement of joy is within such bounds that the mental and the bodily aspects may keep their proper ratio.

2. The mass or substance, so to term it, of joy is made up of a fusion of feelings concomitant to more or less characteristic bodily movements and strains. These movements, psychical and physical, we need scarcely attempt to describe, for the reason that the former are inherently indescribable and that the latter will be more intelligently explainable later on when the underlying principles shall have been set forth. The feeling-mass, however, is properly characterized as a consciousness of

satisfaction, both with one's self and with as much of its environment as is at the time involved with it; thus joy is active happiness in its most complete form, perfect trust for the time in the goodness of life. Joy therefore is pleasant in a degree in which oftentimes mere pleasure is not, for it signifies a satisfied activity, while many pleasures are lessened and their perfection tarnished by an accompanying consciousness of self-dissatisfaction, thoughts of pleasure's fleetness, desire for greater pleasure, or what not. More specifically, the intramotion of joy is a feeling-fusion, a general sort of cœnesthesia varying indefinitely according to the bodily organs active in concomitance, and dependent on the reaction of many shades of temperament and mood upon the yet more numerous surrounding situations serving for the time as object to the emotion. Thus the possible combinations of feelings making up a joy may have elements from three sets of determinants each very numerous: bodily parts, temperamental states, and objective conditions. If, for example, the elements of the first are capable of combining into, say, twenty sets of joy-extramotions, the temperamental tone combinations forty, and objects or occasions say two hundred, we should have theoretically 20 times 40 times 200, or 80,000, sorts or shades of joy possible in the social consciousness of humanity! It is owing to the excess of the two latter of these components that in children and savages joy is so comparatively more frequent, the former exhibiting also an instinctive useful bodily activity which is in itself a source of pleasantness, and the stronger because of the undamaged perfection of functions and sensations.

3. The heightened consciousness of an objective situation as in relation with the agent is a component of joy which may be in origin either material or ideal. This abstracted factor needs not many words in this emotion, and particularly because here the object is less determinative of the reaction than in some other emotions, as for example love, wherein the object determines to a great extent the emotion's mode. It is the interest-forcing quality of the object which determines the degree of the joy, and their valuation to the subject. The objects of joy themselves admit of no classification, so numerous and various are they.

4. The tone of pleasantness of joy has sometimes been considered by psychologists as almost its sum and substance, in earlier centuries in particular pleasure being used as almost a synonym of delight, a usage still met with at times. We have maintained that the affective tone of an emotion, however, is rather an accidental than a fundamental aspect of it, some being very pleasant, some unpleasant, but undeniably some also of such an empirical nature that it is impossible to say which of them obtains in any case. In other words, some emotions have no appreciable pleasantness or unpleasantness whatever, and both they cannot have. But joy is assuredly not of this number, and the strongest aspect of it is pleasantness; it is the type indeed of the emotions of this algedonic class, and this pleasantness seems to determine directly its instinctive extramotion, as we shall show, making it what it is. The pleasantness arises from the satisfaction of desire; from consciousness of the furtherance of the subject's biologic egotism; from the activity as such, essential to the emotion; from that general state of well-being which is denoted vaguely by good nutritive conditions; and, negatively, from the absence from consciousness of worry or unpleasantness, a negative condition brought about by the exclusive attention elsewhere which the emotion practically is.

5. The last component of joy which is distinct, increased self-reference, is an element less conspicuous in joy than in some other emotions, but one which should properly be mentioned, however hard to define in the terms of physiological psychology. This is the egotistic basis against which the emotion's object is apperceived, the standard of the agent's reaction. Of the furtherance of its purposes the ego in emotion seems to be conscious empirically as well as rationally, and in being aware of the emotion's object, the self at the same time is conscious of itself, because in affective states the reactive activity makes up the substance of the emotion, in this case the joy.

We will now go on to the experimental portion of this research into the nature of our chosen emotion. We shall continue the description of the bodily aspect of joy in a way, but shall be particularly engaged in an attempt to determine on a

biological or organic basis why events happen in pleasant emotion as they are known to happen. We shall look somewhat at the 'what' but mainly at the 'why' of joyful extramotion.

It was deemed to be of interest to determine experimentally what degree of uniformity in the extramotion of joy exists when the occasioning object is a constant with all the subjects studied. One may, of course, observe continually, if he look in suitable places, expressions of joyfulness, but he can derive from such observation scarcely any quantitative results or any free from the variation, misleading in its nature, which the very inconstant bodily movements necessitate. The following set of experiments was undertaken, then, under the precisely defined conditions which accuracy requires. The number of the subjects employed was fourteen, and they were, with two exceptions, students in the Harvard Psychological Laboratory; five of them were young women, and the ages of the fourteen ranged between nineteen and forty-five, two of the men being of the latter relative extreme; the ages of most lay between twenty-two and thirty years.

It was primarily necessary that the occasion or object of the joy to be studied should be one that would appeal to all subjects alike and with nearly equal force, and, at the same time, not be so far out of the line of their experience that the conditions should be wholly strange; again, various degrees of stimulus were important, that it might be observed how the emotion varied proportionally to it. No other sort of object seemed to serve these requirements so well as gifts of money; no very wealthy persons, so far as known, being among the subjects, the acquisition of money would be as great a source of joy to one as to another and considerable to all. The only cause of regret involved in the use of money as an occasion of delight was the necessity of the gifts being hypothetical gifts, and not of real cash. Imagination supplied this necessary deficiency, however, for it was the constant endeavor throughout the set of experiments to induce the subject in every case to make the hypothetical money seem as real as possible, by means of repeated auto-suggestion and suggestions from the experimenter acting in the same direction. The subject in each case at-

tempted to consider the supposed conditions actual at the time of each experiment, and then, as it were, read out of his affective consciousness, or will, what he or she *felt* like doing, thus in varying degree putting himself or herself into the actual conditions of the real emotion. It was, in a sense, the reading aloud of felt innervations. It is believed that in the very complex circumstances of the social consciousness, which a human emotion in reality represents, this mode, or other means to suggestion, is the only method available for producing a laboratory emotion under conditions which can be recorded. Hypnotism, of course, would have given the maximum of perfection of a suggested emotion, but it seems inexcusable to employ this agency except for therapeutic purposes—never in the laboratory, or as often, at least, as these experiments demanded. The certainty that these reports of action under the various conditions represent what the person studied would do under real joy of like origin was often increased by the remembrance and comparison of actual conduct under like circumstances in the past experience of the subject. Every person experimented upon was entirely naïve as to the experiment when it was begun.

The method of experimentation in this series was, then, as follows: The subject being seated comfortably, he or she was carefully and emphatically instructed to make the conditions suggested seem as real as possible in each case, then, after a few moments' consideration, to tell concisely what he felt like doing or would probably do under the proposed conditions, the accession of certain considerable amounts of cash. In all cases the suppositions in the circumstances of the gift were such that considerations foreign to the stimulation of a pure joyful emotion were suppressed, that is, no opportunity was given for a conflicting emotion at the death of relatives from whom the money came, no occasion for worry over the possible conditions of its acceptance, nor any other conflicting or inhibiting circumstance, for each hypothetical case represented an absolute and unconditioned accession of so much cash immediately to the subject, without the possibility of doubt. These conditions being understood, one after another hypothetical gifts of ten dollars, one hundred dollars, one thousand dollars, ten thousand

dollars, and one hundred-thousand dollars, respectively, were made to the subject. What then would he or she do under these various circumstances?

There follows a synopsis of the statements in answer to this question, the reported probable extramotions from each different amount being arranged together for convenience of comparison. Each of the fourteen subjects is designated by a letter; the first five are the young women.

Ten Dollars.—Subject *A*, smiles (unless alone) and better spirits. *B*, smiles, rapidly walk the room, put desk in order, look in the mirror, be less attentive to work for an hour or so, better-natured, more lively, mentally and physically. *C*, broad smiles, play on the piano, no study. *D*, smiles, run for sympathy, walk straighter, hold head higher. *E*, smiles, hilarity, singing, or whistling, better humor, reflection. *F*, walk straighter and faster, eyes brilliant, muscles tense, more cheerful than usual, and better natured for a day or so. *G*, smiles, talk to himself or to others more, thoracic thrill, playful attack on his room-mate, active walking, no study. *H*, laughter, talk. *I*, smiles, no joy unless use appeared for the money, train of thought, better humor an hour or so. *J*, smile, nervous walking, stand a little straighter, more talkative, reflective, heart-beat faster. *K*, humming or whistling, get away from the letter (enclosing the money), psychophysically more active than usual, better self-possession, more elastic step, work hard that day. *L*, smiles, restlessness shown in walking up and down, increased sociability, more talkative, laughter at a small joke, whistling, step elastic, faster, erecter, no fatigue, might 'cut' a lecture or two. *M*, hug the money, smile, walk faster, whistle or sing to self, feeling of power, sociability, jig perhaps, work harder that forenoon. *N*, walk faster, body more erect, more affable.

One Hundred Dollars.—*A*, communicative on this subject, thoughtful and light-hearted for some days. *B*, much as before: heart would beat fast, flush, might feel faintish, jump up, run down stairs, treat myself to novel-reading, less attentive to work for a day or so, might hug a familiar chum. *C*, hilarity, jumping, laughter, continual grinning, play Sousa's marches

very loudly on the piano, singing. *D*, run excitedly for sympathy to some one, laughter, embraces, smiles, couldn't study well, might enjoy a walk if an errand were ready. *E*, seclusion and reflection of a melancholic and unpleasant sort, little work for a day or less, none of the common expressions of joy. *F*, more serious in manner, joy being on a higher plane, better natured for a week at least, expression of joy at first less than in the preceding case. *G*, succession of smiles, more joy felt but its expression less, thoughtfulness, restlessness, inattention to studies. *H*, grinning, active talk, walk straighter, would inhibit all expression of emotion. *I*, it would induce a train of thoughts only. *J*, reflection, nervously walk around the room, incipient smiles now and then, more talkative, might romp with my children. *K*, smiles, eyes brighter than usual, vision brighter, pulse and respiration faster, might look in the mirror occasionally, would wish to get out doors, firmer tread, better self-control, less noise than in the preceding case, tendency to smiles, good natured, kinder to people about, apt to work harder. *L*, would seek some crony, playful pugnacity, walk fast, straighter, might celebrate, heart-beat faster, much general physical energy, benevolence, no work for a day or two. *M*, less hilarity, desire and search for sympathy, tendency to quit work. *N*, better spirits, all faculties, mental and physical, accelerated, no work for the rest of that day, meditation.

One Thousand Dollars.—A, meditation or thoughtfulness, seek solitude, repress emotional expression. *B*, would walk round and round room, seek sympathy from some one at once, heart wild, leave work, go to the theatre, vanity, bicycle ride, 'scorching' some perhaps, dance, over-confidential. *C*, would dance, face radiant, later an expression of importance, stand straighter than usual, &c., unusually good-humored and generous, more smiles than usual. *D*, expression as in last experiment, only now I might cry some. *E*, heart wild, melancholy attack: shut myself up in my room several hours with painful thoughts unconcerned with money, absorbed, might either walk up and down or sit quiet. *F*, walk out into the country fast, nervously, exhilaration, might read a novel but should not study, emotional thrill in thorax, more deferential than usual, politer,

bearing confident. *G*, smiles, less hilarity, walk with lighter step, faster, and straighter in position, muscular rhythm, tendency to the thoracic thrill, physical or mechanical work instead of mental, might take a trip away, frequent subdued smiles. *H*, smiles, talk to self, take a walk, whistle, sing, walk straighter, no hilarity. *I*, light a cigarette, omit lectures for a day or two, heart faster in beating, thoughtfulness. *J*, heart-rate greater, nervous and physical excitability, livelier for a week, with more singing. *K*, hilarity, playfulness, great self-possession, walk out, or up and down room rapidly, dignifiedly, cut lectures, confidential. *L*, seek company and sympathy, propose celebration to friends, physical excitability greater than in last experiment, drop work or do it ill, might be boyishly hilarious, talk to self, better humor for a week. *M*, reflection, physical energy greater than ordinarily, seek society, hilarious perhaps, no work. *N*, quieter except might be more talkative, would seek sympathy.

Ten Thousand Dollars.—*A*, should tell 'everybody' about it, excited, talkative, communicative, not hilarious, feeling of responsibility. *B*, general trembling, flush, graveness, take a long walk alone, slowly at first, then faster, confidential with some friend, generous, later hilarious, ride horseback and walk erecter and more firmly in general. *C*, expression would be as in last experiment only it would last longer, some sense and mien of superiority, brief extravagance. *D*, excited but never hilarious. *E*, melancholy attack for a day or two, secluded for several following days, reaction to cheerfulness gradual and moderate. *F*, would jump up and 'holler,' low yells of delight, little laughter, pulse and respiration faster, take a walk by the sea or sail upon it fast, mien alternating between exhilaration and quiet joy, latter lasting the longer. *G*, smiles alternating with periods of seriousness, less bodily movement than in the last case, might take a walk if an errand was at hand. *H*, smiles, might deliberately break some furniture, write letters, seek the crowd and dissipation, smoke Havana cigars fast, wander about listlessly and aimlessly. *I*, pulse faster, smoke, might go to the gymnasium, smiles, hilarity expressed in imaginary fencing or other boyishness. *J*, would act much as in

last case, but the mental and physical activity would be increased, romp with my children, might go to the grand opera. *K*, serious bearing, go out alone for a walk away from people, reflective mood, followed by excitement, rapid walking, seek society, dinner party, etc., kinder to an organ-grinder, more affable. *L*, would seek his family and society, more affable and sociable, couldn't stay alone, sleeplessness, expression of joy more violent than in last case. *M*, less hilarious than in the last experiment but more happy. *N*, disquiet shown by walking up and down slowly, less hilarity than in last experiment, no physical signs of excitement.

One Hundred-Thousand Dollars.—A, would take a quiet walk alone, too excited mentally for hilarity, sense of responsibility. *B*, might faint, then absent-mindedly walk up and down, sighs, hilarity might develop under sympathetic surroundings, erect bearing, self-possession, strength, energy, dramatic posings perhaps. *C*, expression as in last case, only with more dignity and restraint, air of responsibility. *D*, same as last case, seek sympathy, trepidation, no hilarity. *E*, same as in last experiment. *F*, same as last time, save that the excitement would be less and last longer, great degree of self-poise. (*G*, missing.) *H*, great hilarity, smashing all the furniture in the room, telegraph some friends and seek others, alertness, hire a fast span and drive excitement off. *I*, no hilarity, but less depression than in last experiment. *J*, expression as before in some respects, exaggerated in some, and generally lessened by sense of responsibility. *K*, physical excitement less than in last case, dignity preventing hilarity. *L*, quiet walk alone, no hilarity, less impulsiveness than in last case, hilarity might obtain later on. *M*, friskiness, intense hilarity, jumping, waltzing, whistling, power and sense of security shown by poise of head which would be held higher. *N*, would take a trip alone, no hilarity, walk straighter and faster, with head more erect.

From this portion of our research several results in the line of our study appear which are of interest, and also data of suggestive value to an investigation of temperament. Perhaps the most important fact called to mind by these series of joyful

movements, and to be demonstrated by no method perhaps more simple or effective than the one employed, is that joy is emphatically a sthenic emotion. One subject only in marked degree, namely *E*, and two others, *A* and *I*, in much less degree, avowed habits indicative of a general inhibition of the usual extramotion; the first of these was dependent doubtless on conditions verging on the pathological, while the occasion of the exceptional reports of the two other cases was due to an habitual dignity unusual in degree and quite obvious on acquaintance.

The next thing which appears as a product of the experiments is strongly corroborative of the basal principle that joy in its physical aspect stands regularly for expansion and extension of the body, both as to its immediate general occupation of space, and as to its locomotion through space, these being signified by the unusually erect posture, high-holding of the head, etc., and by the rapid walking, sailing, riding or driving which were very general and constant in the answers of the fourteen subjects. The piano playing, singing, loud talking, whistling, etc., are, of course, manifestations which belong in the same logical category. There is, in short and notably, from these experiments an expansion or extension, in a most general sense, of the personality active with the emotion.

A third result interesting to our purpose is the course of the development of the motives for inhibition, with the accession successively of the larger amounts of hypothetical funds, due to (*a*) a feeling of responsibility, (*b*) a sense of dignity, and to (*c*) now and then a touch of pride. Wealth as a source of power is latent activity, which becomes conscious and so kinetic activity (because of the motor nature of ideas) as soon as the shock of its accession is overcome; it is thus not only a source of joy from the pleasantness and pleasure which its spending actually provides, but it acts similarly with an immediate effect at the time of acquisition, because of the firmly fixed knowledge which every person has of it as an occasion of enjoyment in the future. Thus, joy is the realization of desire, which is in turn a motor idea located in whatever bodily organ or organs are to be most directly benefited, in this case, as is most usual, the

whole body. The personality has life-plans expressed in the motor ideas habitual to that self; joy is but the sense of furtherance of that plan, so giving to consciousness satisfaction and very likely pleasantness, and this in turn is correlate with that personal expansion or extension which, we shall later on show in detail, is primal in the extramotion of pleasant emotions. Thus, an increased field is by this biological condition offered to the increased power, personal or social, of the affected agent. Joy may properly be termed the basal emotion, because it is so intimately related with psychophysical activity in the interests of the individual's biologic purposes.

Another result of this set of experiments germane to our immediate subject was so universally taken for granted by the reagents that in their reports they never mentioned it, yet it is of importance for consideration here. This universal presupposition is that joy above all other emotions of man is a condition of excited *pleasantness;* it has a pleasant tone so marked, indeed, that it seemed to some of the older philosophers a mental state synonymous with pleasure itself. Says Sir Charles Bell, however:[1] "Joy is distinguishable from pleasure. It consists not so much in the sense of gratification as in the delight of the conviction that the long-expected pleasure is within our reach, and the lively anticipation of the enjoyment which is now decked out in its most favorite and alluring shape." In this emotion, no doubt or uncertainty of judgment existing as to its algedonic tone, joy stands unequivocally for pleasantness, just as it is often a derivative of pleasure, either present or in certain prospect. Thus all mankind and perhaps the higher brutes seek joy as foliage the sun, or at least that general complex of pleasant exhilaration, mental and bodily, empirically known to all men, for which joy is as proper a term as any other. If often persons are to be observed who exhibit an inhibition, more or less complete, of all joyous extramotion, we may well postulate that in these cases the will, long become habitual in its mode, finds greater personal satisfaction in the suppression of the bodily correlates for the greater benefits derived from the supposedly larger or more important or at least more desired ends.

[1] Anatomy and Philosophy of Expression, p. 152.

We may safely say, in general, that any emotion, other things equal, is pleasant to its subject in proportion to the energy which it expends, whether it be used, as the primal instinct impels, in the bodily movements which we may fairly term typical of that emotion, or in the inhibition of these movements accompanied by the consequent frequently greater intensity of the psychic side of the experience. If an emotion has in it unpleasant or painful elements, logically accidental to the emotion as such, these may, of course, overcome the pleasantness inherent in the activity; such, for example, is the case with fear, the most unpleasant of the emotions, and, as Mosso says, 'a disease to be cured.' Here in proportion to the activity manifested by the agent the experience is less unpleasant, the fright which kills at times being of the sort of which we say 'he was rooted to the spot.' Thus it appears that in general emotion is pleasant in proportion to its all-round energizing when other conditions, vital to the sustenance of the feeling of personality, do not obtain to counterbalance the biologic psychophysical tendency. It will appear, therefore, that, although the extramotion in general in the emotions of a savage or of a child appear to be more extensive than those of a highly developed, that is artificialized, adult of the United States, still the general plane of the emotion of the uncivilized agent is somewhat lower, because his mental complexity is less and hence the probability of confliction within the psychic series is materially decreased. The emotions in the naïve are, then, apparently both purer and more intense, but of a biologic automaticity which the cultured adult has outgrown, whether for ill or good.

Out of the maze of psychologic description and doctrine of the agreeable and the disagreeable, one fact at least seems fairly well agreed upon, namely, that in general pleasure and pleasantness make for a furtherance and pain and unpleasantness for a hindrance of the vital functions of the ego experiencing them. This is assumed as the foundation principle of a biologic science of feeling, and, although with pleasure and pain as such we are not at all concerned in a discussion of emotion, but only with pleasantness and unpleasantness, the notion is of prime importance to the doctrine of joy. This furtherance, then, which

agreeableness indicates to any animal means to the biologic egotism of that animal growth, development, enlargement, expansion, extension, increase of the influential sphere of that ego by whatever mode it may be brought about, and whether psychically or physically or, as usually needs be, by the cooperation of both these aspects of selfness. To the mind, furtherance means greater influence, deeper worth and import, fuller satisfaction of the personal life-plans. To the body, it means augmentation and extension, either literally and immediately through change in form or movement of the limbs and organs, or else through locomotion, thus affording still another kind of extension and of its efficient energy's increase.

A notion of this relation, of this concomitance between spiritual and bodily furtherance, has been in a more or less vague way not uncommon in the minds of men of all periods. It is said that in some ancient Stoic philosopher's writing may be found the statement that bodily extension corresponds to pleasure of the mind, and contraction to pain. Paola Mantegazza, in his late interesting and systematic 'Physiognomy and Expression,' quotes from a book entitled 'Physiognomical Cephalogy,' by Cornelio Ghiradelli, published in Bologna in 1672, saying that pleasure extends even "to zoöphytes and animate plants, like the oysters and sponges, which contract as an effect of pain and which dilate with joy to the point of opening," and thus from Honoratius Niquetius's 'Physiognomia Humana,' published at Lugduni in 1648: "Voluptatis primus et maxima propius effectus est dilatio cordis sanguine et spiritu ad exterioris partes copiose effuso, unde et nonnullus gaudio propter nimiam spiritum jacturum, mortuos esse legimus * * *" Darwin indicates by his second principle of emotional expression an antithesis between affective movements and strains which is tenable only when taken in this sense. In the work of the poets the idea is of frequent occurrence in one or another form more or less significant. Schneider drew attention to its zoölogical relations. Professor Muensterburg first made the notion, however, a part of physiological psychology in a brief article in which he calls attention to the principle and carries it out to its logical conclusions as regards feeling.

This concomitance between feeling of pleasantness and of unpleasantness as pure consciousness and the respective bodily concomitants of each of these two sorts of feeling may be viewed, of course, from two points of view. From the one there is given a series of chiefly muscular movements and strains and we can observe what modes of feeling accompany them when analyzed into their obvious varieties as extensor and flexor. From the other view-point we can study the effects which pleasantness and unpleasantness, as such, have upon the muscular movements again as extensor and flexor.

With the former of these two possible methods of research we shall have relatively little to do in this essay, and that notwithstanding that it is philosophic to consider that it is rather, biologically speaking, the muscular and other bodily reactions which are primary from the phylogenetic standpoint. These are instinctive and based on hereditary and imitative habits in every organism. In the complexes of any empirical emotion, however, it is not possible to introspect and to say that from the contraction of the extensor muscles alone comes the experienced pleasantness; other factors enter in and confuse the certainty of the analysis. But it is open to the consciousness of any person adequately introspective that contraction of the extensor muscles gives a greater degree of agreeableness to its subject than does contraction of the muscles anatomically classed as flexor. This opinion has been arrived at independently as the result of almost instinctive observation by many, and has been proven by the writer, both by a series of experiments conducted for the purpose and by many others made with other intention. For example, if it may be allowed to anticipate a little for the purpose here, out of 1,328 voluntary extensor and flexor movements of the forearm through an arc of about forty degrees, two-thirds of the extensor movements were greater than the norm set for imitation, while the flexor movements were as often greater than the norm as they were less, but no more so. Both sorts of movements were accompanied by a faint degree of pleasantness, but those which were extensor evidently gave the more. The conditions in this case were equally favorable to extension and to flexion. But more certain even than such

evidence is that of each man for himself, who, by the simple experiment of comparing the consciousness of the two sorts of movement (arms, head, trunk and legs), may assure himself that extension is more pleasant than flexion. This great fact, simple as it is, adds an important presumption to the phylogenetic theory of affective states, for it proves that pleasantness inheres in the very muscles when moving or strained, and that aside from the agreeableness arising from the mere activity as such. Whether in vital history the muscular movements preceded the pleasantness and unpleasantness or the contrary it would be an unwarranted presumption to declare at present; indeed it would be unphilosophic perhaps to say that either one preceded the other, eternal concomitance being probably the teleologic fact.

But practically, as regards experimentation in the psychological laboratory, the balance is not so perfect, for it is impracticable to make artificially an extramotion of joy, for example, and then to analyze the muscular feelings, as has before been said. On the other hand, to apply to the subject experimented upon a 'stimulus' which is pleasant or unpleasant, observing then the muscular and other bodily reactions, is certainly working nature backwards in a sense, such stimulations being wretchedly inadequate as producers of organic feelings of any extensity, and withal antecedent when they normally are concomitant, or perhaps at times consequent. This is the chief of the limitations which laboratory conditions demand of a research into the nature of emotion in normal subjects.

This series of experiments was carried out in the Psychological Laboratory of Harvard University throughout the college years 1895–1896 and 1897–1898. About a third part of this portion of the research has already been published independently, as of interest in itself, the article being entitled 'Involuntary Motor Reactions to Pleasant and Unpleasant Stimuli,' in No. 5, Vol. IV. of *The Psychological Review*. This portion of the experimental work was done with the able coöperation of Mr. Frank N. Spindler, now of the Michigan State Normal College.

The first part of the research deals with the reactions of the hand and of the head in the opposed algedonic tones. These

parts were chosen because they are the most mobile portions of the external members of the body, the fingers in particular having a motor sensitivity excelled only by that of the respiratory muscles and of the heart. This is an empirical fact quite in line with the principle that, other conditions being equal, the most mobile parts are those most used; furthermore, inertia would tend to make the smallest muscles the most mobile. The head gets its high degree of mobility from the former of these two considerations hardly less than from the unique perfection of its balance upon the axis, maintained by very many small and delicate muscular bundles. We should expect therefore *a priori*, that, if any part of the organism showed extreme sensibility to changes in the affective tone of pleasantness and unpleasantness, it would be the fingers and the head. Our first problem for solution is, Is the extenso-flexor balance of the muscles of the hand and neck disturbable by such tones of pleasantness and of unpleasantness as are applicable to the subject under laboratory conditions?

The mechanical plan for the direct registration of the possible extension and flexion of the bodily parts now to be studied was as follows: The subject was seated in a comfortable chair with arms. A tightly-fitting pasteboard cap was then placed on the head from the center of the top of which cap a strong silk thread extended, over an easy-running pulley to the end of the lever-arm of a Marey tambour. Because the antero-posterior movements of the head were found to be in some cases considerable, this arm was made about 25 cm. long. By a careful centering of the pulley in the circle of the head's movements, all record of the occasional lateral motions of the head was avoided, account of these being of very minor interest in this research. Pneumatic pressure transferred in the usual way the rise and fall of the tambour's arm to the pen of another Marey tambour, tracing on smoked paper on a rotating drum.

The apparatus applied to the left hand consisted of a bulb small enough to be fairly grasped in the closed fist. No little difficulty was experienced in finding a bulb without so much resistance to compression that the subject's constant attention was necessary to keep it in the state of partial compression

necessary to secure record of the extensor movements of the fingers. But at last a bulb made of a soft sponge from which the middle portions had been cut, enclosed in thin rubber dam, was suggested, and this served as a most sensitive and, indeed, generally adaptable piece of apparatus, for sponges may be found or cut of any desired degree of resilience. The varying pressure of the hand enclosing this bulb was, as before, pneumatically carried to a receiving tambour and recorded on smoked cylinder-paper at the left of the tracing made by the head.

To register the reactions of the right hand a different form of apparatus was arranged. About the second and third fingers, selected as the most sensitive and powerful of the five, a comfortable ring of brass foil was fastened. This was attached directly to the lever-arm of a tambour and as close to its fulcrum as possible, that any movement might be emphasized, and it was adjusted so that when the fingers and hand were moderately flexed the tambour-head was plane. Perfect comfort of the hand was found to be of great importance here, in order that voluntary attention to it and its reactions might be the more successfully avoided. The flexor and extensor movements of the fingers were, as before, recorded on the cylinder, but this time at the right of those of the head.

The more easily to secure a constant pressure at the start in the three sets of apparatus, the open ends of branches from the three conducting tubes were arranged side by side convenient to the operator, and fitted with clips so as to be simultaneously closed when all was ready and the kymograph in regular motion. The speed of the recording cylinder was such that one rotation was made in about five minutes. The cylinder was 14 cm. in diameter and 25 cm. long, being large enough for two records such as these without change of paper. Straight 'normals' were regularly run round the drum for the better measurement of the record-curves.

A complete account of the various conditions of each experiment was written with a stylus on each sheet, including the subject's name, temperament, subjective experiences, the stimulus, nature of its affective effect (whether pleasant, the con-

trary, or neither), data and direction of the muscular movement in each reaction. The subjects were mostly seniors and juniors of Harvard College, of Radcliffe College and graduate students of philosophy working in the laboratory. Their number was nineteen. Inquiries as to emotional likes and dislikes were regularly made, and as to their musical and 'artistic' education.

The emotional stimuli mostly used were odors, although sounds and variously colored light were employed to a much less extent. It was eminently desirable in every case that the stimuli employed should be as purely pleasant and unpleasant, whichever it was, as possible; this demand odors seem to satisfy immediately and almost always well; again, many subjects were employed and very many experiments made on each, and odors were the most convenient in application. Indeed, it has seemed to the experimenter over and over that odors furnish about the only unequivocal means of affording a pleasant stimulation in a general university laboratory, especially in researches where a considerable number of subjects or 'reagents' are employed. Again, odors are unlimited in number, thus suiting all subjects sooner or later; and they are relatively free from irrevalent and undesirable associations. It was much more difficult to find for every subject a number of positively disagreeable odors than to find agreeable ones, students of chemistry being especially hard to suit with a sufficiently disagreeable smell. Constant care was needed and exercised to suit the tastes of the subjects in this regard, the object regularly being to employ as stimuli typical and emphatic examples of what was judged respectively agreeable and the reverse.

The particular olfactory stimuli employed were contained in ounce vails kept on a convenient stand made for them. It is hardly possible to make any classification of these odors as pleasant or unpleasant, so erratically do tastes differ in this affective field. Roughly, however, they may be arranged in the following order of agreeableness to the greater number of the particular young men and women employed; the most pleasant comes first, but the middle members of the list, of necessity, vary very largely in this respect. The list is as fol-

lows: Oil of bergamot, cologne water, heliotrope, methyl acetate, oil of cloves, musk, ethyl iodide, spirits of turpentine, xylol, eugenol, oil of eucalyptus, iodoform, cider vinegar, carbon bisulphide, ethyl borneol and camphor, sulphuric ether, toluidin, allyl alcohol, asafœtida, diamylamine, acetic acid, and ammonium valerianate. A few subjects avowed no strong unpleasantness from any of these, and for these ammonia was employed in place of a real odor. It will be observed that 'disgusts' were not included among the stimuli, associations being undesirable in these experiments, which were with pure affective tones.

Panes of glass about 30 cm. square, colored red, blue, green, and orange, were used for the subjects with the color-taste highly developed, the panes being held for a few seconds each before their eyes. Similarly, for subjects musically inclined, such sweet tones as tuning forks can give were applied as stimuli, with harsh noises for the contrary intent. These two forms of stimulus seemed to have only minor advantages over odors, one of these being that they tire the perceiving end-organ somewhat less quickly than odors do; but they were more pleasant to the subject on the average than were the disagreeable members of the olfactory series, thus to that extent serving less well, while being much less easily applied with the precision both in time and space which accuracy requires. All these considerations have important application throughout this whole set of experiments.

During the five minutes of each experimental period (this being the time required for one revolution of the record-cylinder) from three to seven stimuli would be applied, varying with the nature of the odor, whether lingering or not. Each time the subject indicated whether the stimulus was pleasant or unpleasant to him, and this judgment served as the basis for the counting of the record made. Each subject was instructed to sit quietly during the experiments, yet not strained nor stiff, making no voluntary movements whatever. It was interesting to note that only very exceptionally was there any awareness of the involuntary flexions and extensions which occurred in the hand and head, the eyes, save in the case where light was used as stimulus, being closed.

The numerical results of this portion of the experiments were as follows, summarized and explained:

Under Pleasant Stimulation.

Taking each movement or lack of movement, whether of the head or of either hand, as a separate case, there were recorded 500 effects of sensory stimuli which were judged pleasant by the subjects. Of these, 118, or 23%, were cases of flexion of the hands or forward (flexor) movement of the head; 134, or 27%, were cases of no reaction whatever, and 248, or 49.6%, were cases of extension of the fingers or of backward (extensor) movement of the head. Considering the actual reactions only, there occurred *68% of movements of extension and only 32% of flexions*—a proportion of more than two to one. The tendency under pleasantness is therefore proven strongly toward extension, so far as the human hand and head are concerned.

The two hands and the head did not necessarily act together in the same way. The left hand appears much more sensitive to involuntary reaction than the right, and this was to be expected perhaps, most of the subjects being right-handed and, therefore, with their right hands 'civilized,' so to say, away from the original biologic habits of emotional concomitance.

Counting the cases of pleasant stimuli when the left hand showed no reaction, there were for the left hand under stimuli judged agreeable these results: Flexion, 21%; no reaction, 19%, and extension, 60%. Out of 184 stimulations the left hand flexed 37 times; did not react 35 times, and extended 112 times. Comparing the left hand with the right, the percentage of 'no reactions' is seen to be much the less for the left hand, while that of both flexions and of extensions is greater. Under pleasant stimulus the right hand showed: Flexion, 20%; no reaction, 40%, and extension, 40%. That is, in a total of 130 cases, the right hand flexed 27 times, did not react in 51 instances, and extended 52 times. The left hand, then, was indifferent 19% while the right was indifferent 40%; it flexed 21% while the right flexed 20%; and it extended 60% while the right hand extended only 40%. Leaving out the cases of 'no re-

action' *the right hand flexed 34% and extended 66%; but the left hand flexed 25% and extended in 75% of its opportunities.*

As for the *head* under pleasant stimulation, it was found to flex in 29%; it did not react in 26% and it extended or drew back 45%. That is, in a total of 186 pleasant stimulations, the head bent forward 54 times; bent backwards 84 times; and did not react 48 times. Comparing the flexions with the extensions alone, the head under agreeable stimulation was flexed 39% of the possible times, and extended 61%. The head was, then, more 'indifferent' than the total average results, but more reactive than the right hand. It will be observed that the head displays more of a tendency to flex under pleasant stimuli than does either hand,—viz., 29% of flexions to 20% for the right hand and 21% for the left hand. This was one of the surprises of these experiments: in many cases under pleasant stimulation the head would flex even when both hands extended or relaxed. At first this was supposed to be true only in cases when odors were used as stimuli and because of the necessary mode of applying these to the nose, but it was found that the same fact obtained when colors and sounds were employed. This must be an adaptive movement, for often, after this flexor reaction, the head would extend during the continuance of the pleasant stimulation. We shall observe the same phenomenon in the legs later on.

Under Unpleasant Stimulation.

If now the head movements in response to unpleasant stimulation be examined, similar differences of reaction will be seen. Under this circumstance it flexed 43%; gave no reaction 19%; and extended 38%, or in a total of 168 cases it moved forward 72 times; showed no movement 32 times; and inclined backwards 64 times. Taking flexion and extension alone, there was 53% of flexions compared with 47% of extensions. Even more marked here is the tendency for the head to extend under an unpleasant stimulus than there was for it to flex under a pleasant stimulus, while both hands flexed. Yet for the head also flexion predominates. Comparing the hands as to their reaction and sensitivity to unpleasant stimuli, we find the

right hand here also markedly more inhibited (or 'indifferent') than the left, for the left hand shows flexion 66.7%; no reaction 14.5% and extension 18.7%—or in 165 cases it flexed 110 times; gave no reaction 24 times; and extended 31 times. Leaving out the cases of 'no reaction,' it gave 78% of flexions and only 22% of extensions.

The right hand, however, flexed only 49.5% of the times; while it failed to react 29%; and extended 21%. Comparing flexion and extension cases alone, the right hand flexed 69% and extended 31%. The right hand, therefore, exhibits more tendency to indifference and to extension under disagreeable stimulation than does the left hand. We find, then, in the hands a marked preponderance of flexions under unpleasant stimulation, 78% of the left hand's movements and 69% of those of the right hand being flexions.

Combining the cases of the reactions of the head and hands under the influence of disagreeable stimuli, there were of flexions 53%; of cases of no reaction 29%; and of extensions 26%, or in these 450 cases there was flexion 240 times; no reaction 90 times; and extension 120 times. Leaving out the occasions when no reaction occurred, *there were just 66⅔% of flexions to 33⅓% of extensions under unpleasant effective tone*, a proportion of two to one.

Under Indifferent Stimulation.

In the cases when the stimulated feeling was pronounced by the subject indifferent, that is, neither agreeable nor disagreeable, some interesting results were obtained. Even here the left hand proved readier to react than the right. The left hand under indifferent stimuli showed flexion 34%; no reaction 31%; and extension 34%; or in 32 cases flexion 11 times, no reaction 10 times, and extension 11 times. It will be observed that the flexion and the extension are equal.

The right hand under indifferent stimulation was less mobile. Its results were: flexion 30%; no reaction 50%; extension 20%; or in 20 cases of 'indifferent' stimulation the right hand flexed 6 times; made no reaction 10 times; and extended 4 times. Leaving out the cases when it did not react, it flexed 60% and extended 40%.

The left hand showed only 31% of cases of no reaction under indifferent stimuli while the right hand showed 50%. The head under indifferent stimuli gave 30% of flexions; 30% of 'no reaction'; and 40% of extensions; or 43% flexion to 57% extension, disregarding the immobilities.

The total results for the hands and the head for indifferent stimuli are 31.7% flexion; no reaction 35%; and extension 32.9%; or, disregarding cases of no reaction, flexion 49% and extension 51%. Extensions here then are almost equal, the degree of extension preponderating being too slight to be greatly significant either way. There were in this series 35% of no reaction to 26% under pleasant stimulation and 20% under unpleasant stimulation.

Summary and Additional Observations.

The foregoing results may be seen almost at a glance in the brief table below; it includes only the actual reactions to affective stimulation sufficient in size to be recorded by mechanical means; these were in number 764. The cases in which the reaction, if any, could not be recorded numbered 253 in addition, or a total of 1,037 experiments in this portion of the research.

	Stimulation Unpleasant.	Stimulation Indifferent.	Stimulation Pleasant.
Flexion.	66.6%	49%	32.2%
Extension.	33.3%	51%	67.8%
Proportion.	2 to 1.	Nearly equal.	1 to 2 +

These experiments afford therefore a *striking confirmation* of the general theory which we shall use—namely, that there is underlying organic affective movements a strong tendency to extension or expansion during agreeable states, to flexion or contraction during disagreeable states, and that in a most literal as well as in the most general and even figurative sense. Other tendencies are shown to obtain, however, some of which conflict with this tendency; such, for example, as the predisposition to move toward an object which attracts attention; the inclination to move away from a disagreeable object; the tendency to make particular movements of adaptation to stimuli, etc. It must be

further constantly borne in mind that in all cases the conditions are necessarily inadequate to furnish in the laboratory stimulations which are of an unmixed and strong character suitable to a complete affection of the whole organism or of the whole consciousness. Further circumstances of great interest and importance which cannot be as yet taken into consideration at all are connected with the individual psychology of the persons who served as subjects in the experiments, namely vague but doubtless all-pervading influences due to temperamental or moodal conditions. These offer here, as almost everywhere else in experimental mental science, material for research in a direction of their own, but they can here receive no further discussion, chasms too broad and yawning opening up on every hand.

Let us now look into some of the conditions under which these foregoing results, so strongly and indeed so unexpectedly corroborative of the presumption we are investigating, have been secured. Especially must we consider the relative states of evolution of the different species as regards their emotional habits, and how those of the higher ranges of development have been affected by their present modes of biologic life. For example, the extensor-flexion correlation whose validity we are investigating has been changed in its tenor in the slow course of the innumerable generations in which any species has become what it at this stage is. These changes must be looked at briefly, for they seem to strengthen immensely the force which for biology and reality this dual principle has.

Philosophically speaking, the amœba is the lowest and most simple member of the animal kingdom, because it is exactly one simple cell, of which, metamorphosed in an almost infinite variety of adaptive ways, all animal bodies are composed. In this very animal mass of living protoplasm, then, the pleasantness-extension principle (so to call it, for short) is exemplified in its purest and most typical way, and the whole law is therein revealed. When the amœba's biologic egotism is progressing, when it is in the state of pleasantness or in what to us humans is pleasantness, its fluid bodily mass is extended, whether in feeding, in reproducing, or in 'enjoying' the satisfaction which

must surely come from its normal activity. On the contrary, when irritated, even by jarring, whenever its self-satisfying course of conduct is disturbed or checked, the animal at once tends to contract into the very form of smallest possible surface-extension, the approximately globular—that is, in unpleasantness it flexes within itself. This is the instance as typical and perfect for the hypothesis as were possible, and the directness and simplicity of its action are remarkable in this at once the philosophic and morphologic type.

As development in any higher species has become more advanced and generally, therefore, more elaborate, complications are encountered which make the empirical phenomena more difficult to see, and which, indeed, somewhat affect their natural purity. There are many reasons for this: for example, one organ must be used for many sets of functions; variations in mood and in temperament change the physical conditions and the affective tastes both at once; structure often makes extension and flexion impossible in this typical perfection; certain series of muscles, etc., grow into those motor habits which their most frequent use has made inevitable, and in the cases in which these habits conflict with a free exercise of this principle, it is the latter apparently which is repressed.

But again, teleologic reasons make the relative perfection of this originally purely protective tendency of greater use in the lower orders of animal life than in the higher. For the greater safety of the unintelligent low forms it is important that unexceptionally the pleasant should be the advantageous, 'expressed' by activity of expansion and of approach, and that the unpleasant should be harmful, correlated in the body by withdrawal and flexion. But with the added intelligence of discriminative power, it might be that the advantageous might well enough be unpleasant and *vice versa*, as we know empirically is the fact is some of the at present highest species. Very often, indeed, with us, unpleasantness is agreeable to us, and even pain may be so far in accord with the nature of the ego at the moment as to advance its purposes and so give the essential satisfaction, if not actual pleasantness, for these two abstractions shade off into each other, and cannot properly be always discriminated.

Thus, the subjects in the above outlined portion of this research could not in every case be certain that the tastes of their organism, so to say, agreed precisely with those of their personal moods at the moment of reaction. These innumerable tendencies, indefinitely opposed to the underlying principle, prevented complete constancy of the reactions, as the representing figures show. Such, to be sure, must continually be found to be the case in every reactive—that is, psychophysical—experiment on the higher organisms. In this case, it will be recalled, the persons whose respective degrees of correlation were recorded were among the highest levels of civilization and development, subjects whom beforehand one might well expect to be as far away as any practically obtainable from forms of life which would show the perfection of this extenso-flexor correlation. The brutes, could they tell what their judgments were in such experiments, or savages, or young children, we may fairly presume would exhibit series of reactions very much more nearly approaching uniformity than even our recorded proportion of more than two to one. On the whole, then, we may grant that the principle has received very strong experimental proof, despite the disadvantageous conditions of a university laboratory research, from the set of experiments just detailed.

The next most mobile limb of the body, although a part exceedingly less mobile and with much more inertia than the fingers, is the arm, and in particular the forearm. This, therefore, was next studied in respect of its sensitivity and extramotion to agreeable and disagreeable affections of the general consciousness. In this set of experiments (conducted, like all the rest save the series just described, by the author alone) the investigation was directed toward learning how far the motor principle in question varied extensive movements *voluntarily* made by the subject, the immediately preceding set having dealt with reactions quite involuntary and most often quite unknown even to the consciousness of the subject. For the carrying out of this purpose apparatus was arranged in a manner which will immediately be described. It has the merit of simplicity and the requisite of precision. The apparatus consisted of a sheet of

heavy white pasteboard fixed horizontally on the top of a rather high table. On this smooth surface radii five degrees apart and covering a total circular arc of 110° were drawn in heavy black lines, each marked in degrees counting from both ends of the arc. At the centre of this segment a large cylinder of cork was placed and so fixed on a pivot as to rotate evenly and easily, the top being hollowed so as comfortably to fit the olecranon process of the ulnar bone. To the palm of the left hand of the subject, seated comfortably in the position proper for easy movement of the forearm over the table, a sharp-pointed brass stylus, fastened to strong but light splints on either side of the wrist, was fixed firmly with bandages. These narrow splints served to keep the hand rigid and straight in relation with the forearm (without motion at the wrist), and the stylus in a constant position on the palm of the hand. Thus when, as was always required of the subject, the stylus was vertical, its point, gliding just over the surface of the card, was a true indicator of the movements of the forearm about its fulcrum, the elbow-joint. A bit of wood held in the hand of the operator served to limit the varying backward and forward movements of the arm when the norm for imitation was being taken. Between the subject and the table was placed a screen made of black cardboard, bellied out before the face, and with an aperture in the centre of this recess 13 cm. square. It was arranged that squares of Bradley's colored papers should be exhibited to the subject through this opening; these were held one at a time by a clip sliding on the smooth upper edge of the screen.

The stimuli employed were these colors and in addition a set of odors. The color-stimuli were fifty-five in number, and consisted of Milton Bradley's standard saturated colors, intermediate colors, and one tint and one shade of each color. Each of these stimuli-sheets had a consecutive number on its back by which it could be recorded in connection with the reaction caused and the judgment as to the affective tone produced. Besides these colors there were employed as stimuli, but not quite as much, a set of twenty-five odors, the same series already described above with the addition of two more pleasant numbers, jockey-club and lily-of-the-valley perfumes. These were contained and applied as already described.

Such being the simple-enough apparatus of the present set of experiments, the methodical routine of conducting them was briefly as follows: The subject being seated so that his or her elbow rested in the padded and pivoted cup and in such a position that extreme extension of the forearm placed the vertical stylus on the radius marked 0°, the stylus point was placed by the experimenter carefully on radius 1, 2, 3, or 4, each representing as many decimals of circular degrees; this was the starting-point of the performance of the norm. Then the subject, the eyes being closed, carefully attending to the kinæsthetic experiences in his arm, flexes the forearm until the stylus touches the wooden ruler held by the operator about 40° further round. The hand was then quickly carried back by the experimenter to the starting-point (this being always a purely passive movement on the subject's part), and, a sheet of the color-stimulus having been meanwhile placed in the aperture of the screen, the subject opened his eyes upon the stimulus and at once imitated the best he (or she) could the previous flexion at one sweep and at a constant rate of movement. The angular difference, plus or minus, between these two voluntary movements (the norm being always the former of the two) was then recorded in circular degrees, together with the subject's judgment as to the pleasantness, indifference, or unpleasantness of the stimulation, the number or identity of the color, and the portion of the whole arc covered by the movement as to its position. The judgments were made in seven grades, each having a symbol, the digits from one to seven, the empirical maximum of agreeableness being called one, indifference four, and the maximum of disagreeableness seven. This notation is both convenient and precise. The procedure when odors were employed as stimuli was the same, save that they were applied to their appropriate end-organ. Here, too, as always, the eyes were closed, that the attention might be the more fully on the joint and muscle sensations in the arm.

This same process was then effected in the direction of the arm's extension, the stylus being placed at 8, 9, or 10, the voluntary movements then ceasing about 40° further on toward complete extension of the forearm. Thus, continually, as long as the

subject's sitting lasted, a flexor and an extensor imitative affective movement were alternated, a norm in each case, of course, preceding each imitation, starting at various degrees both of flexion and of extension.

Besides the reactions made under stimulation, many experiments were performed which should serve as a necessary foil or basis for judgment of the affective reactions. These were conducted in precisely the same manner in all respects as the others, save for the absence of stimuli; in these the imitation was of course more perfect. The results are tabulated below under the head of 'normal experiments.'

The left arm only was employed in this series of experiments, it having been proved in the last set to be more biologically naïve, less trained and 'civilized,' than its homologue the right. Throughout, great care was exercised to stop the work at once when either the arm or the olfactory or visual end-organ was in any appreciable degree fatigued.

The subjects in this experimental set were eight in number, all students in the Laboratory, and two of them (women) students of Radcliffe College. In age the subjects ranged between twenty-one and forty-five years, two having the latter age.

The subjective reports of introspection as to the methods by which the proper length of the second or imitating movement was determined have a bearing here and are in part briefly summarized. One subject reported that his attention was upon the movement directly more when the stimulus was unpleasant than when pleasant; he was guided in his movements by muscle and joint sensations, visualizing only when a position was suggested to him. Another subject said he noticed that a degree of inhibition was required to stop the arm at the proper place when the stimulus was unpleasant, there being then also more of a tendency to jerkiness; he visualized the spot where he judged the movement should end. Another was guided by 'muscular sensations expressed in visualized distance.' Quantity of muscular and joint sensations, then, and a visualized image of the hand at the final position, were the two more ordinary criteria for making the judgments of distance.

The total number of movement-experiments made in the

series was 1,328, divided as follows: With colors as stimuli, 574; with odors, 326; and without stimulus, 428.

It is noticed that the conditions of these experiments were made very different from those of the preceding set on the hands and head. Primarily, these were *voluntary* movements of a limb of considerable size made through a rather extensive arc, disturbing elements arising from the arm's momentum being therefore unavoidable. But it was especially desirable that the influence of feeling-tones, pleasant and unpleasant, on just such voluntary actions as these might be investigated, emotional extramotion being constantly to a greater or a less degree superimposed upon our ordinary habitual voluntary movements. The complexities of voluntary acts so greatly exceed those of reflex or of subconscious movements, that one would in advance not expect any such uniformity of reaction to affective organic tones as was exhibited by the mobile fingers and head when left free to follow the underlying tendency of their motor nature. There are present in this set of reactions, then, conflicting conditions which make the probability of uniformity of reaction more improbable even than in the last experimental set, while all the inevitable deficiencies in the artificial imitation of emotional tones are present to disturb here, as there.

The actual results obtained from these 1,328 reactions are summarized, as far as figures allow, in the accompanying table. The numbers indicate percentages; very nearly the same number of judgments of pleasantness as of unpleasantness were recorded, the odors and colors judged as 'indifferent' being, on the other hand, considerably fewer.

VOLUNTARY ARM MOVEMENTS.

		EXTENSION.		FLEXION.	
STIMULUS.	MOVEMENTS.	EMOTIONAL.	NORMAL.	EMOTIONAL.	NORMAL.
Pleasant	Less.	33.3		48.6	
	Equal.	2.8		4.1	
	Greater.	63.6		47.3	
Indifferent	Less.	29.0	30.0	43.1	40.9
	Equal.	9.1	3.3	11.1	4.3
	Greater.	61.9	66.6	45.8	54.5
Unpleasant	Less.	33.9		47.4	
	Equal.	2.8		4.2	
	Greater.	63.3		48.4	

It will be observed from this table that there exists a very large tendency to exaggeration of the imitation in case of extensor movements of the forearm, these being larger than the norm in these experiments in fully two cases out of three. The flexor movements show nothing of this, but are about half too large and half too small, as the theoretical probabilities would prophesy. This extensor excess is doubtless due to the inherent over-pleasantness of extension; the greater power of the flexors precludes any explanation on the ground of sthenic agreeableness. Furthermore, it is worthy of note that this extensor excess was less in the emotional reactions than in the normal imitations where division of the attention between the arm's sensations and a stimulus was absent.

Disregarding the normal, test, movements and comparing solely the results as to the effects of pleasantness and of unpleasantness on the length of the voluntary movements, the following numbers are collated, forming a percentage

SUMMARY.

MOVEMENTS.	STIMULUS.	EXTENSION.	FLEXION.
Greater	Pleasant.	63.6	47.3
	Unpleasant.	63.3	48.4
Less	Pleasant.	33.3	48.6
	Unpleasant.	33.9	47.4

There is, then, in every one of the four cases compared a numerical difference which is invariably in favor of our principle. As regards the extensor movements this is exceedingly small, and even in the flexor reactions little significant, when compared with the results obtained from the experiments with involuntary reactions of the fingers. In words this summary means this: In simple voluntary imitative movements of the forearm, the extensor movements are more often greater than less under pleasant stimulation or feeling, and more often less under unpleasant feeling; on the other hand, flexor reactions of the forearm are more often greater under unpleasant feeling, and less under pleasant feeling. More simply stated yet, agreeableness makes extension of the forearm proportionally greater and flex-

ion proportionally less, and *vice versa*. Under the circumstances of a large limb moving with no little momentum through a considerable arc this completeness of correspondence with our principle in each of the four cases is both interesting and conclusive, however small the preponderance which the figures prove. The tendency as a basal organic law is again by this set of experiments certified.

Logically to complete in a systematic way the study of these affective influences, a somewhat similar set of experiments was next undertaken to investigate how the *leg* reacts to pleasantness and to unpleasantness, and again involuntary movements or reactions were to be studied. Whenever the will is active in determining effective extramotions, its effect it seems is chiefly of an inhibitory sort (a fact which is important for judging the foregoing results). On the other hand, the leg is adapted by its very perfect hinge joint at the knee to express involuntary motor tendencies, although its considerable weight and consequent inertia would seem to make probable a record of only the most powerful of the motor impulses.

In the last third of this portion of this research then, the intent was to register any involuntary movements of extension and flexion of the leg in relation to the thigh which might occur. The left leg was employed, for reasons like those which proved the left arm more suitable for the purposes of studying instinctive actions,—namely, its less degree of 'civilization.' Here we are studying some of the largest muscles of the body and quite the largest of the joints. The apparatus employed to adapt these conditions to those of the possible reactions may be described thus:

The subject sat in a chair set on a table, his left thigh comfortably supported in a canvas swing hung between wooden supports, the leg thus being able to swing with the utmost freedom to and fro. To the lacing of the shoe (by this means its pressure on the foot was equalized) a cord was attached which passed over a firmly-supported pulley and was tied to a balancing weight, this pulley being centered so as to be equidistant from the extremes of the foot's motion, and the weight being adjusted

for every different leg and foot so as just to balance it and allow of extensor movement being as easy as flexor. To the tibial crest on the anterior surface of the leg and just beneath the patella tendon there was bound by tight but comfortable bandages a short pendulum swinging on fine knife edges and attached to a scale graduated to degrees from either side of its central point; the scale then was rigid with the swinging leg, while the pendulum served as a plummet quickly stopping at the vertical position. This pendulum and scale was made by W. Cehmke in Berlin, and with its many joints and adjustments is a useful instrument. The scale, swinging with every movement of the leg, indicated at a glance, to a small fraction of a circular degree, the exact position in which the leg stopped swinging in relation to the place at which it was before the stimulation was made.

The stimuli employed in these experiments also were odors, they being the same used before with the addition of an extremely agreeable one, attar of rose; this made their number twenty-six, ranging from the most generally liked to some of the most disagreeable of smells—aside from disgusts, whose use had no purpose in this research.

The subjects this time were ten in number, properly all men, mostly those employed on former occasions, young men of the Laboratory.

The routine of the experimental method was as follows, the subject having been carefully instructed to sit in the chair in a constant position and posture, and to attend solely to the odor during each experiment, with eyes closed, and without voluntary movement of any muscle. The pendulum-scale being bound on and the leg and foot very carefully balanced by the required weight at the end of the cord, so as to swing one way no more easily than the opposite from a certain point midway between the extremes of flexion and of extension, the scale was adjusted so that swinging normally the leg returned to the exact zero-point each time. The subject then took from the rack of vials, convenient to his right hand, one of the odors, while the experimenter drew down the weight balancing the foot and leg to a support beneath, by this means making the leg's initial ele-

vation and consequent swing on release of the weight constant in amount. At this, the signal agreed upon, the subject applied to his nose the stimulus as the leg was let swing by the experimenter, the stimulation being continued during the two or three seconds or more required for the foot to come to complete rest. Then the degree of the limb's extension or flexion was recorded in degrees, together with the subject's judgment on the tone of the stimulus, whether pleasant or unpleasant, in one of seven degrees as before, and the number of the odor. Great care was used to at once stop the experiments whenever either nose or leg gave any feelings of fatigue; this often occurred in twenty minutes or a half-hour, thus making these, like all experiments with odors, comparatively slow work. The various stimuli were used in nearly equal extent, except that the more powerful ones being properly those of greatest value, they were employed more often than the commonly indifferent members of the list.

Normal experiments, that is, reactions when no stimulus is given, were not required in this set of experiments, for the reason that the scale was each time adjusted to the zero-point, to which the normally swinging leg would in every instance return. The number of the experiments was 801. Their numerical results are given in the table which follows:

INVOLUNTARY LEG MOVEMENTS.

STIMULUS.	PLEASANT.			INDIFFERENT.			UNPLEASANT.		
Reaction.	Extnsn.	No mvt.	Flxn.	Extnsn.	No mvt.	Flxn.	Extnsn.	No mvt.	Flxn.
Cases.	138	111	139	14	17	24	65	113	180
Per cents.	35.6	28.6	35.8	25.5	30.9	43.6	18.2	31.6	50.2

Expressing these numbers in words, pleasantness causes the leg to extend in 35.6% of the stimulations of that tone, to flex in 35.8%, and neither in 28.6%. Unpleasantness caused flexion in 50.2%, extension in only 18.2%, and no change of position in 31.6%. Odors which were called indifferent in affective tone caused extension in 25.5% of their cases, flexion in 43.6%, and

no reaction either way in 30.9%. It is these last movements, those under indifferent stimulus, which are properly to be taken as the norm of the experiments, the affective state being in these cases *as in an emotion without appreciable algedonic tone.* We should not properly compare the reaction obtained with that made when no stimulus at all was applied, but rather with the reaction from an indifferent stimulation, the conditions of the method being such as to allow of no reaction of any sort when no stimulus was applied. An indifferent stimulation caused a neutral affective tone, and this alone is the normal standard of the reactions.

Comparing with this normal standard the results obtained under pleasantness, we find that there then were more extensions than flexions: in the ratio of 35.6 to 25.5. On the other hand, unpleasantness caused more flexions than extensions (as 50.2 to 43.6) and also fewer extensions (in the ratio of 18.2 to 25.5). Again, disagreeableness gave rise to flexions in over half the reactions under it and only 18.2% of extensions. These comparisons are observable at a glance almost in the following scheme or

SUMMARY.

Reaction.	Pleasant.	Indifferent.	Unpleasant.
Extension.	35.6%	25.5%	18.2%
No movement.	28.6	30.9	31.6
Flexion.	35.8	43.6	50.2

Here again we see further demonstration of the correlation between tone and bodily movement, the flexor tendency in this case being emphasized. From these experiments also were compiled data which would be valuable in a study in individual psychology or of temperament, for the ten subjects varied greatly in their modes of reaction and in the numerical results from compilation of their leg movements. One subject reacted to pleasantness with 53.3% of extensions and 31.6% of flexions, while under unpleasantness his leg exhibited 38.8% of flexions to 22.4% of extensions. This was the subject all modes of whose reactions most favored the principle. Again, one or two were relatively deficient in extensor reactions under all circumstances.

It would appear from the collected figures that the individuals who react least, who are least emotional, when they do react are strongly of the flexor tendency. This would seem, for several such reasons as are above suggested, to be one of the most fertile fields for the study of individual psychology of the affective aspect of mind.

The concluding portion of the experimental part of this present research was conducted in the Psychological Laboratory during the first three months of 1899. It relates to the vascular and respiratory movements and conditions concomitant to joyful consciousness. These changes, as Lange has shown, probably take a preponderating part in the experience of emotion, making up much of its substance or mass, and it is unfortunate that our access to these variations should be at present so imperfect and so uncertain, in a way, in result. On man, who can express in words his feelings to us, we cannot adequately experiment; while the lower animals, which, unfortunately, some persons deem it proper sufficiently to explore and study, cannot adequately convey to us the tone of what they might feel, whether pleasant or unpleasant, weak or strong. On this account affective psychology seems greatly handicapped until some possible new mode of approach to the vascular secrets of higher organisms shall be evolved. As it is, we study really only some indefinite exponent, so to say, of the real variations, and for this relation no formula exists. A sphygmogram represents the emotional changes in the vascular organism in some degree quantitatively, but none too well; indeed, no single curve, especially in one plane, could ever represent the mechanical conditions of a hydraulic system so complex.

Eleven subjects were employed in this research, all, save one, students of the Columbia courses in Psychology, all males, and with ages between twenty and thirty years. There was among them a considerable variation in emotivity.

To study the vascular movements in joy a sphymograph was employed, this instrument and method being better indicative of the blood changes as a whole than the plethysmograph. The sphymograph employed in part was of the Marey pneumatic

form, the greater part of the work, however, being done with a mere simple brass tambour with a light cork rod attached by a wide base to the rubber's surface; this tambour was supplied with an arm by which it might be tightly clamped and so applied by means of rods and universal joints to any artery on the surface of the body. This device was found to be of far greater utility for work like this than the instruments made especially for each artery, but which are difficult and slow of adjustment and often uncomfortable to the patient and constrictive of the artery investigated.

The instrument with which the studies on the respiration were made was the excellent and simple pneumograph of Fitz, consisting of a thin rubber tube about 3 cm. in diameter and 20 cm. long, stretched over a light brass-wire spring, this being closed at one end and connecting with the transmitting tube at the other; straps fastened this pneumograph around the abdomen of the subject at any place and at any degree of tension.

The sphygmograms and pneumograms were traced on gas-smoked paper attached by springs to the surface of a kymograph drum. This drum was 95 cm. in circumference and 26 cm. in width, and was rotated on a vertical axis by an electric motor (with gearing to reduce the speed), once in about four and three-quarters minutes, or about one centimeter in three seconds, the record being produced so as to read naturally, that is, from left to right. The recording-pens were actuated by Marey tambours attached to a carriage controlled by the groove of a screw in such a manner as to descend a proper amount at each rotation of the drum, the amount being adjustable. By this means a continuous record of a half-hour or more was possible. The pens were of very thin sheet copper, giving a delicate and finely detailed curve; a time-line, run by a pendulum beating seconds in another room, served also as a base-line from which to measure the departure of the curves.

The stimuli employed in this part of the research were, in the main, those used in the preceding portions, and the same difficulties are present. The constant endeavor was to induce in the subject pleasant feelings best described as joyous by whatever means this could be brought about. Induced states of

humor and of pleasantry were frequently occasioned by reading to the subject humorous or witty passages from books, the telling or reading of jokes, and by other similar means. In other cases the subject was directed suddenly to recall to mind some well-remembered state having a strong pleasant or unpleasant tone, some pain or pleasure, some agreeable or disagreeable tone still fresh and strong in the mind, aiding the effect by auto-suggestion that the conditions were then immediately present. This was found, as in a former set of experiments, to be a ready and powerful stimulus in most cases. Oftentimes these purely mental or imaginary stimuli were assisted by real odors, such as were used before, among them being attar of rose, heliotrope, ammonium valerianate, and tincture of asafœtida. More pleasant stimuli than unpleasant were employed in the present experiments, descriptive facts as regards joyful intramotion being here what were desired, with a knowledge of the nature of laughter. The same (hypothetical) gifts of money above considered were employed likewise in some cases with interesting results. A condition of mirthful and exhilarated good humor or delight, as the nearest laboratory approach to natural and instinctive joy, and induced and ended as suddenly as possible, was the state which was repeatedly produced and studied in the various subjects.

The arteries from which the results are combined were the radial, the carotid, the temporal, and the tibial, which in the main showed no marked difference in the type of their reaction to the psychic tones. Certain dissimilarities between the central and peripheral arteries seem to obtain, those nearer the brain showing the most marked reactions.

The problem here, then, was to learn the vascular and the respiratory extramotions of joy. Each of these, so far as represented by the record-curves made from them, may be studied in three ways or directions with more or less success: the pulse as regards its general pressure, impact upon the arterial walls, and frequency; the respiration, in respect of its time-occurrence, the relations of inspiration and expiration, and the quality of each stroke. These results of these experiments may be given *quantitatively* as well as qualitatively in a space propor-

tionally small. It is by such comparative and quantitative conclusions that knowledge about the emotions will gradually increase.

The most universally constant effect of pleasant simulation upon the *vascular system* seems to be an increase in arterial pressure throughout the body and especially upon its surface. This is represented in the sphygmogram by a rise of the pulse line in the shape of an arch varying in altitude from a portion of a millimeter to a considerable fraction of the centimeter with the recording instruments here employed. The condition is the accompaniment as well of all active mentation whether affective or cognitional, but in no case else seems so emphatic as in suddenly induced conditions of a joyful nature, being then constant and often marked. The carotid artery seems to display this reaction to the best advantage.

A reaction due doubtless more directly to the increased cardiac kinetic energy is the extension in the width of movement which the pulse pen makes at every beat, this being found also in disagreeable states in about the same degree. Owing probably to mechanical conditions, the widening of the excursion is not seen to be a constant phenomenon, but is often marked. It would seem that the increase in question as measured on the sphygmogram may be stated fairly at twelve per cent. over that of the non-affective normal excursion, or when the mind is not forcedly active in any way, ranging between ten and twenty per cent. This increase is more or less dependent on the quickness with which the heart's left ventricle contracts, and this varies with the tension of consciousness, joyful tension being particularly easy and emphatic.

Further evidence of the sthenic nature of emotion when of a pleasant tone is to be found in the acceleration of the pulse occasioned by the stimuli employed. It is probable that in this reaction is also to be seen evidence of the excitement factor of beneficial emotion, this being sometimes the only appreciable quality of an affective state when the pulse-rate is distinctly increased. This effect we may report quantitatively, the instances cited being average examples of the total number of such reactions. The counting was done in many cases, and an equal

number of seconds of normal pulse and the joyful pulse were compared. In only two or three cases was no acceleration perceptible; it ranged from three per cent. up to twenty per cent., with an average acceleration of about seven per cent. The subjects varied little in this respect. It was observable that pleasant odors did not occasion the increase that imaginary and immediate psychical tones produced. As was the case also in regard to the width of the pulse curve, the acceleration was most marked at the beginning of the stimulation, sometimes then reaching for a few beats an acceleration of forty or fifty per cent., thence continuing its emotional rate until it decreased rather suddenly in general when the affective state was forcibly closed by change of attention-point.

The *respiratory* extramotion of joy seems to be somewhat less definite and simple than that of the pulse. This is as would be expected *a priori*, for while the heart is probably controlled chiefly by one nerve arising from one spot in the medulla, the respiration is directed through the action of several nerves having among themselves much more various relations with the cortex, notwithstanding that the respiratory center proper is localized somewhat restrictedly in the calamus scriptorius; the ordinary muscles of the process certainly have far wider and more various control.

On the application of a pleasant stimulus such as has been described, the first inspiration is usually much deepened over that of the normal, indicating an enlargement or extension of the thorax. This increase as measurable on the pneumogram record varies from perhaps ten per cent. to ninety, with an average fairly statable as about twenty-five per cent. It is to be noted here as in the case of the pulse that the effect of pleasant odors, giving what may at times be properly termed pleasure, sometimes of a marked degree, do not produce this inspirational reaction with the regularity that ideal stimuli and joyful occasions proper produce, and this in spite of the fact that the natural tendency is to inhale a delightful odor as deeply as possible. The natural rhythm between the respiration and the pulse tends to be retained at all normal times, and to this must be ascribed the observed fact that the succeeding respirations, after the first,

are smaller, then requiring less time, and so being able to keep up with the accelerated pulse.

It is observable in addition that in delight the respiration tends to be carried on deeper in the chest than during unpleasant states, indicating a more or less continued contraction of the diaphragm. This unusual exercise of the chief muscle of respiration is in itself a pleasantness until prolonged to fatigue, as may be experienced by any one at will.

Whether or not acceleration of the breathing is to be considered a concomitance of joyful feeling it is difficult to say from study of the record curves of this research. At times an increase in the rate is distinctly apparent, but at others the deepening of the breaths seems to cause an opposite effect. This seems to be borne out by observation at large, an excited joy producing sometimes a rapid respiration-rate, especially when the emotion is of a light degree, while deep joys, containing little of the excitement element but much to affect profoundly the welfare of the self, exhibit deep, slow breaths. The pleasant odors employed as stimuli seem to occasion a slowing rather than an acceleration, while the purely mental modes of stimulation seem in a long run of seconds to accelerate the breathing into rhythm with the hastened pulse.

Laughter was described to some extent by the tracings on the smoked paper. First there is a very deep inspiration, which is usually in part only released before a series of irregular, very short vibrations of the pen occur, indicating a clonic spasm of the diaphragm; at the end of three or four of these smaller contractions a somewhat larger one occurs, followed by a forced expiration; then several more spasmodic movements occur, ended, in a mild laugh, with a strong expiration and a deep compensatory inspiration, when return to the normal amplitude takes place, usually with a feeling of decided pleasantness from relief from the unwonted fatigue of the diaphragm and the smaller accessory muscles of respiration. During an attack of laughter nearly every muscle of the body is in some degree innervated, the extensors in particular, as has been shown, and the pulse-curve therefore is inevitably disturbed beyond the possibility of translation. The diaphragmatic vibrations chiefly productive of

a moderate period of laughter seem to be in number from ten to thirty complete vibrations, with an average of about eighteen. The amplitude of these clonic contractions of the diaphragm is ordinarily not more than a tenth or a fifteenth of the normal contraction, but, because of their unwonted tension, they are quickly fatiguing and therefore soon cause, if continued, a 'doubling-up' of the trunk to relieve the strain on the diaphragm as well as upon the other extensor muscles of the body.

We have now obtained from thousands of experiments on actual subjects under careful scientific conditions evidence from practically every accessible portion of the body that the pleasantness-extension theory has its basis in the very nerves and tissues of the organism. This evidence has in fact been obtained under adverse conditions, the subjects being highly cultured civilized adults, and the necessary laboratory limitations making the stimuli employed very far from those acting in natural conditions, all the states studied, moreover, only approximating those of 'real life.' We will now attempt to apply these basal principles, and to point out, in some measure at least, why the familiar general manifestations of joy are what they are known, instinctively almost, to be.

The extramotion or 'expression' of joy is characteristic in about an average degree, there being emotions (as anger and fear) which have more characteristic expressions and others (such as love and hate) which have less. The bodily correlation which is most characteristic of the emotion in all its degrees is the smile and laugh, while the rest of joy's extramotion is composed of actions performed also to some extent in other emotions, and especially in those in which pleasantness is prominent, as pride and love. Preyer in his 'Die Seele des Kindes' reports that the mouth of his child smiled during sleep (from the reflex pleasantness arising from a hearty meal) on the tenth day after birth. Joy from music, from being spoken to, from a bright face, caused lively movements, the general accompaniments of pleasantness, in the first week. Even on the first day Preyer thinks pleasantness caused wide opening of the eyes, and a little later an animated gleam in them (from activity of the

lachrymal gland). Alternate stretchings and bendings of the extremities in pleasant bath or when the piano was played were regular activities from the second month, 'multiplied and associated with very loud joyous shoutings' later on, as in the seventh month, with lively kicking when put to bed, when fed, and when placed in a strong light, the last being a phenomenon observed in adults by the present writer on several occasions. Only in the ninth or tenth month do there occur striking of the hands together and laughter for joy, quite different from the reflex laugh of earlier months. Monkeys and dogs are often seen to smile, while birds come very close to it sometimes, as well as, and probably more properly, other animals.

Laughter is produced by clonic spasms of the diaphragm and other respiratory muscles, of most of the facial muscles, especially those round the mouth, while there often obtains an increase of intra-orbital pressure which causes a slight protrusion of the eye and finally an excretion of tears. The upper part of the mouth and the lower jaw are drawn upward and the head often backward, the back too being straightened even to the commencement of flexion backwards, until (and this often happens soon) fatigue-pain in the diaphragm and accessory abdominal muscles causes a marked ordinary flexion of the trunk for its relief, as above observed. The vascular pressure seems meanwhile to be usually increased with consequent general glandular and visceral activity.

The precise muscles involved in laughter as the typical joyful extramotion may be set down as follows: their location and even their names have interest in the light of the principle implicated in their action here. Besides these listed there are many others, of course, especially in the neck and about the vertebral column, which are not mentioned, they being too numerous and too small.

The Diaphragm and the nine or ten other muscles productive of respiration.

Risorius, Zygomaticus major and minor, Levator labii superioris, Levator labii superioris et alæque nasi, Levator menti, Orbicularis palpebrarum, Pyramidalis, Dilator naris posterior and anterior, Superior rectus oculi, and Corrugator supercilii; these in the main make the facial extramotion.

Splenius capitis et colli, Obliquus capitis superior, Rectus capitis posticus minor, Erector spinæ, Biventer cervicis, Complexus, Trapezius, and Cervicalis ascendens; these extend the head.

Longissimus dorsi, Multifidus spinæ, Sacro-lumbalis, Accessorius ad sacro-lumbalis, and Spinalis dorsi; these, with various large muscles joining pelvis and thigh, extend the trunk.

In joy (as in extreme grief and suffering sometimes) cries of a very high pitch are uttered, the heightening being due probably to contraction of the Crico-thyroideus and Crico-arytenoideus posterior muscles.

A general synopsis of the extramotion of joyous emotion includes movements of bodily parts such as these: When very violent, very general bodily activity of undefinable variety is the rule in those animals and conditions where it is pure joy. Dancing, jumping, shouting, running, clapping the hands, turning somersaults, less definite universal movements occur, in short any violent exercises conducive to the excited and sthenic feelings of the inner experience, all interacting with the heightened vascular and respiratory and glandular functions. Sir Humphry Davy, it is often related, danced with joy in his laboratory when he discovered sodium, while all the world knows how Archimedes on a certain historical occasion ran wildly through the streets shouting Eureka!

In the lesser and ordinary degrees of joy and often, for reasons we have already rehearsed, when the inner joy, so to say, is really excessive, all this is modified and mollified to a set of phenomena appearing quite different. There are smiles or the more complicated laughter, accompanied by all the numerous signs of psychophysical excitement which every emotion implies. The eyes are brighter and the upper eyelid elevated, as also are the brows, the skin over the glabella, the upper lip, and the corners of the mouth; while the skin at the outer canthi of the eyes is puckered. The nostrils are moderately dilated, the tongue slightly extended and the cheeks somewhat expanded, while in persons with largely developed pinnal muscles, the ears tend somewhat to incline forwards. The whole arterial system is dilated, with consequent blushing from this effect on the

dermal capillaries of the face, neck, scalp and hands, and sometimes more extensively even, from the same cause, the eyes slightly bulge. The whole glandular system likewise is stimulated, causing the secretions—gastric, salivary, lachrymal, sudoral, mammary, genital, etc.—to be increased, with the resulting rise of temperature and increase in the katabolism generally. Volubility is almost regularly increased, and is indeed one of the most sensitive and constant of the correlations in emotional delight.

Aside from these extramotions which are general to joy, there are for every special instance of it certain sets of actions which correspond to the objective situation which is the affective state's occasion, all, however, having the common quality that they are directed in such a way as to bring the subject into closer and more intimate relations with this object, but either literally or figuratively as the case may be.

Now, all these varied and ever-varying movements, so great in number and so unique in themselves as to be well-nigh indescribable as they appear in life, seem to have one common characteristic in so far as they are undisturbed by conflicting principles of action or restraint or by disturbing tones of feeling. They are all at once proofs and products of the biologic principle that pleasantness is correlated in living organisms by vascular, muscular and glandular extension or expansion, both literal and figurative. Joy, in other words, is an extension or expansion of the personality in both its aspects, mental and bodily. The mental expansion is manifest in the fast talking, singing, shouting, whistling—by one's 'good spirits' which stand for an enlarged viewing for the time of life's broad good. There are *feelings* of well-being, of self-confidence, of freedom, and of power. There is *willing* of kind, great, or famous deeds, of conduct which shall make the delightful experience permanent to the enlarged benefit at least of the agent. There is *cognition* of practical optimism, while it lasts, that it is joy itself to be alive. The bodily expansion or extension is manifested by the 'open countenance,' the 'broad smile,' the erect bearing, the expanded chest, by the naturally raised and extended arms and spread fingers, with sometimes separated legs, and

extended feet and toes, and in special cases by numerous other bodily extensions, such as, in brutes, the erect tail and proboscis. Again, the frequent tendency to rapid walking and running or riding, rowing, sailing, the piano-playing, waving of flags, throwing upward of hats, jumping, shouting,—all these and other like movements display activities as far as possible from the life of grief.

But in a sense much more particular than this is the extra-motion of the emotion of joy the result in the main of extensor movements, for, properly classed, that is with due reference to morphological principles, practically all the muscles involved are extensor muscles. The muscles which extend the trunk and the head are ordinarily classed as extensors from their effect when contracted. So far as is known to the writer, however, it has never been pointed out that the facial muscles likewise are readily classifiable as flexors and extensors, their mechanical effects not being of sufficiently practical importance in anatomical physiology to make such disposition of them important. It will be shown, however, that the facial muscles are no exception in the data of myology in this regard. A few considerations will, it is presumed, make this statement clear to an extent materially to assist explanation of affective facial expression, thus helping in some measure to reduce the long-standing mystery of the face, the mirror of the soul's affections. These considerations are at once morphological and physiologic.

Even as the affective principles are manifested almost, if not quite, as early as animal life itself, so must one search very early in the embryo for the forms which are determinant of adult structure and function. Function is more primary, properly, than form, and one generation determines to some extent invariably the structural pattern of the next. We must look, then, to the early embryo for the direct correlation of the functions which are to obtain in the adult. Although the primitive streak is at first necessarily straight, folding begins very early, and at the end of the first month in the human fœtus the embryo is bent upon itself to a very marked degree. The curve which forms in the region, afterwards the lower cervical, is for our purpose the most significant, although the growth forward of the anterior

cerebral lobes helps in the case of man to make this antero-posterior bending more marked and more physiologically significant. This curvature is in the adult quite patent in all the canals which extend from before backwards in the head. First, in the ventricles of the brain from the third to the 'sixth' down the cord. Second, from the nostrils upward and backward and then downward into the trachea. Third, from the mouth similarly upward and backward and downward into the œsophagus. All of these in a proper philosophic sense outline even in the higher adult forms the curve which at the period of individual development when the functions of the muscular system were being firmly established in the formative plan of the organism is even more plainly apparent. In the forms of a strongly prognathous type of structure these conditions are all emphasized, as they are in animals with long probosces which these muscles in part serve conspicuously to extend. It is at this early formative period that the myological system is beginning to take its basal opposition of flexion and extension, the large muscle of the scalp, the Occipito-frontalis, being the strikingly complete type of this functional division, the frontal half drawing directly backward in a way to tend to extend the face and head.

But on the same dual principle do all the superficial facial muscles act, of course including those which we have above detailed as the facial mechanism of the smile and laugh. The Risorius draws upward and backward the corners of the mouth. The Zygomatici have similar effects upon the jaw. The Levator labii superioris, as its name implies, lifts the upper lip, as does the Levator labii superioris et alæque nasi and in addition the outer and lower walls of the nostrils. The Levator menti lifts the soft parts of the chin. The upper portion of the Orbicularis palpebrarum raises the skin about the eyes, and the Pyramidalis that over the root of the nose. The Dilatores naris lift and expand the lower portions of the nose. The Rectus oculi superior rotates upward the ball of the eye. The Corrugator supercilii raises the inner ends of the eyebrows until the latter are straight. All of these, physiologically speaking, tend to straighten the curve which, morphologically, extends from the upper portion of the vertebral column to the chin, and hence tend to complete the extension of the body.

It is thus seen that the muscles of the face which take part in the pleasant emotions, and particularly in joy, are extensor in the same sense as are those of the hand, neck, back, forearm and leg, although the form of the face and its complex functions make their division in this manner less obvious than the muscles of the rest of the body. They complete and corroborate the condition found experimentally to obtain elsewhere.

The facts are now sufficiently in accord to warrant the maintaining of a postulate important for the 'philosophy of expression,' statable as follows: The pleasantness-extension and unpleasantness-flexion *principle will apply in emotions in general in proportion as they are pleasant or unpleasant to the agent.* Some affections are very pleasant, and these exemplify the principle one way; others are unpleasant, the converse movements and strains are seen; while many which are neither markedly agreeable nor disagreeable will employ this biological tendency to no appreciable degree. This is in the nature of a corollary to the biologic principle which we have experimentally proved. Recent researches by N. Wedensky[1] have shown the complete opposition of certain motor centers in the cortex, excitation of one extensor center augmenting the excitability of the flexor center of the other hemisphere and diminishing the irritability of the flexor center of the same side. This supports our conclusions arrived at empirically and experimentally, and makes more certain still the law which seems deeply to underlie the materialization of the emotions.

The main contentions of this monograph may be briefly restated thus:

Somewhat in proportion to its proper pleasantness, an emotional extramotion consists in expansiveness and outwardly in contraction of extensor muscles; this is true of the smile and laugh of joy, the fundamental emotion of life.

The regular occurrence of habitual inhibitions, due to complex conditions of civilized social development, supplies the apparent deficiency in the kinæsthetic theory of the emotions of man.

[1] "Jrnl. ochranenia narodnago zdravia," 1897. "*Année Psychologique.*" Vol. 4, p. 449.

Analysis discriminates five components of a period of emotion,—namely, psychophysical excitement; various feelings and their concomitant bodily movements and strains; heightened consciousness of the emotion's object as in relation with the subject-agent; often a pleasant or an unpleasant tone of consciousness; and at times increased self-reference.

Any emotion, being biologically in animals, savages, and naïve infants a more or less constant series of phenomena, is theoretically at least susceptible of future scientific determination more or less exact; while the emotional processes of civilized human selves are so complicated by social interactions as to be no longer properly emotions in the biologic sense, but rather concrete expressions of the affective social consciousness at present quite indefinite.

An emotion is an affair invariably of both a mind and a body, practically the whole of the latter of which it regularly implicates in its movements: it is dynamogenic.

Contraction of the extensor muscles is more pleasant in itself than contraction of the flexors, and this fact, together with the general tendency to flexion which a (naturally unpleasant) sudden shock produces, perhaps determined, phylogenetically, the empirical opposed mode of affective extramotion.

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VITA.

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